

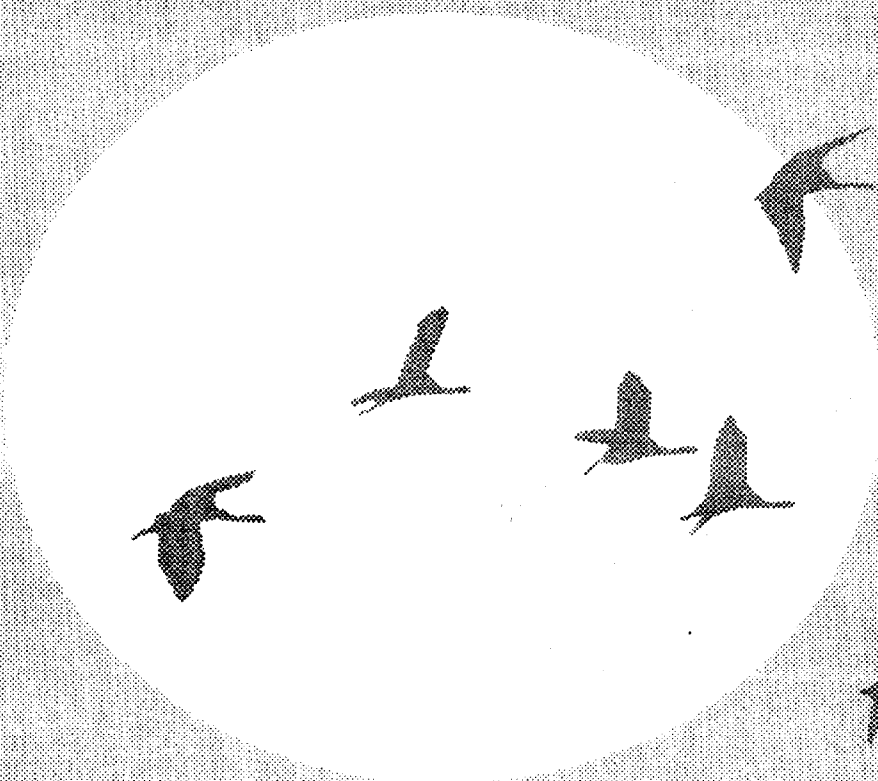
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**VERIFICATION SURVEY
OF THE
PHASE II REMEDIAL ACTIONS
ALBANY RESEARCH CENTER
ALBANY, OREGON**

T.J. VITKUS

Prepared for the
Office of Environmental Restoration
U.S. Department of Energy



ORISE

OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

Environmental Survey and Site Assessment Program
Energy/Environment Systems Division

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ALBANY, OREGON**

Prepared by

T. J. Vitkus

**Environmental Survey and Site Assessment Program
Energy/Environment Systems Division
Oak Ridge Institute for Science and Education
Oak Ridge, TN 37831-0117**

Prepared for the

**Office of Environmental Restoration
U.S. Department of Energy**

FINAL REPORT

APRIL 1993

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U.S. Department of Energy.**

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The author would like to acknowledge the significant contributions of the following staff members:

FIELD STAFF

P. R. Cotten *
R. B. Slaten

LABORATORY STAFF

M. A. Laudeman

CLERICAL STAFF


K. E. Waters
T. T. Claiborne
S. L. Sartin


ILLUSTRATOR

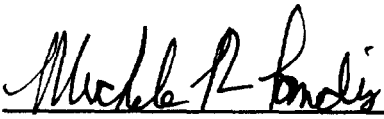
E. A. Powell

* Currently with Martin Marietta Energy Systems

VERIFICATION SURVEY
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PHASE II REMEDIAL ACTIONS
ALBANY RESEARCH CENTER
ALBANY, OREGON

Prepared by:  Date: 4/8/93
T. J. Vikus, Project Leader
Environmental Survey and Site Assessment Program

Reviewed by:  for Date: 4/8/93
W. L. Beck, Acting Laboratory Manager
Environmental Survey and Site Assessment Program

Reviewed by:  Date: 4/8/93
M. R. Landis, Project Manager
Environmental Survey and Site Assessment Program


Reviewed by:  for Date: 4/8/93
J. D. Berger, Program Director
Environmental Survey and Site Assessment Program

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**VERIFICATION SURVEY
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ALBANY, OREGON**

INTRODUCTION

The Albany Research Center (ARC), located in Albany, Oregon, was established in 1943 and operated by the U.S. Bureau of Mines. The initial site activities were to investigate innovative approaches for developing strategic mineral resources in the United States, as well as manufacturing processes and other metallurgical research. In addition to these activities, ARC conducted operations for the Atomic Energy Commission (AEC) and the Energy Research and Development Administration (ERDA), predecessor agencies of the Department of Energy (DOE), during the period from 1948 to 1978. Operations involved the melting, machining, welding, and alloying of thorium. Research activities also included the separation, purification, and processing of limited quantities of uranium. Waste materials from these activities, commonly containing low levels of thorium, uranium, and their associated decay products, were treated and placed into temporary storage and/or disposed of on-site. In addition to the previous work performed for the DOE and its predecessors, ARC continues to conduct work with radioactive materials, some of which are the same as those used in the AEC/ERDA/DOE activities, under the jurisdiction of the Nuclear Regulatory Commission.

As a result of the AEC/ERDA/DOE operations, portions of the ARC became radiologically contaminated. In 1978, Argonne National Laboratory (ANL) conducted radiological surveys and the site was subsequently designated for remedial action under the DOE's Formerly Utilized Site Remedial Action Program (FUSRAP).

In 1984, Bechtel National, Inc. (BNI), the Project Management Contractor (PMC) for FUSRAP, conducted additional radiological surveys of areas identified by ANL to define the locations and levels of above-guideline contamination.¹ Remedial action to decontaminate identified areas was initiated by BNI in mid-1987 and completed in February 1988. Eleven structures were addressed in the 1987/1988 (Phase I) remedial action activities; they were Buildings 2, 4, 5, 17, 19, 23, 27,

28, 29, 30, and 31.² However, Phase I verification and subsequent characterization surveys identified additional surfaces with residual radioactive material contamination that had not previously been designated under FUSRAP.³ Contaminated surfaces included building floors, walls and ceilings, pipes, conduit, trenches, equipment and other miscellaneous items. BNI established that thorium-232 (Th-232) in natural isotopic abundances was the primary contaminant. Uranium-238 (U-238) was also identified in a few building locations as the only contaminant or as a co-contaminant with Th-232. In addition, radium-226 (Ra-226) was also determined to be present as a minor contaminant in a few localized areas, which included drain residues and soils. The areas included in the Phase II remedial actions are in or adjacent to Buildings 1, 2, 3, 4, 5, 17, 23, 24, 25, 26, 27, 28, 29, 30, 31, 33 and 34 and the Lime Pit east of Building 31. Phase II remedial actions were initiated in August 1990 and were completed during April 1991. Remedial techniques included scabbling surfaces, vacuuming, excavation, wood planing, paint removal, grinding, and physical removal and restoration of structures and equipment.

It is the policy of DOE to perform independent verifications of the effectiveness of remedial actions conducted within FUSRAP. The Environmental Survey and Site Assessment Program (ESSAP) of Oak Ridge Institute for Science and Education (ORISE) was designated by DOE as the organization responsible for this task at the Albany Research Center. Verification of the Phase I remedial actions was conducted between August 1987 and April 1989 and is the subject of a separate report.⁴ From September 1990 through April 1991, ESSAP conducted Phase II verification activities in the aforementioned buildings. These activities, which are the subject of this report, included reviews of pertinent documents and independent radiological measurements and sampling of most remediated areas. Preliminary findings were previously discussed in three interim reports.^{5,6,7}

PROJECT ORGANIZATION AND RESPONSIBILITY

DOE Headquarters provides overview and coordination for all FUSRAP activities. DOE Oak Ridge (DOE-OR) is responsible for implementation of FUSRAP, and the Former Sites Restoration Division of DOE-OR manages the daily activities.

Under the standard FUSRAP protocol an initial investigation, or designation, of a potential site is performed by ORISE or Oak Ridge National Laboratory (ORNL) under contract to DOE

Headquarters. If appropriate, DOE Headquarters designates the site into FUSRAP based upon the results provided by the initial investigation. DOE's project management contractor for FUSRAP is BNI. BNI is responsible for planning and implementation of FUSRAP activities and managing the site characterization and remedial actions. The final phase for a FUSRAP site is independent verification, which is provided by ORISE or ORNL after remedial action is complete. The verification survey provides independent support for the DOE that remedial actions at the site have been effective in meeting current guidelines or identifies inconsistencies and discrepancies in site status. In addition, documentation is reviewed to insure that it accurately and adequately describes the post-remedial action radiological condition of the site. DOE Headquarters uses the information provided during remedial activities and verification to certify that a site can be released for unrestricted use.

SITE DESCRIPTION

The ARC facility is located approximately 110 kilometers (70 miles) south of Portland, Oregon (Figure 1) on a 17-ha (42-acre) site of the former Albany College in Albany, Oregon. The site is bounded on the north by Queen Avenue, on the east by Liberty Street, on the south by a tennis club facility, and on the west by Broadway Street (Figure 2). The site consists of three main areas: ARC proper (the main research facility); the former Biomass Research Facility which consists of approximately 0.8-ha (2-acre), located south of the main facility; and a 5.7-ha (14-acre) undeveloped area, known as the "Back Forty," occupying the south end of the facility. There are 34 buildings and several smaller structures located at the ARC. Most of the buildings are currently being utilized. Several of these buildings are interconnected through adjoining hallways and rooms.

PROCEDURES

OBJECTIVES

The objective of the ESSAP verification activities was to verify that the BNI-managed post-remedial action surveys, sampling, analyses, and associated project documentation provided an accurate and complete description of the radiological condition of the property.

DOCUMENT REVIEW

The BNI-prepared characterization report, hazard assessment, and hazard assessment addendum, and the Phase II post-remedial action report were reviewed for general thoroughness and accuracy.^{3,8-10} Instrumentation, data, and survey procedures and results presented in these reports were reviewed and compared to established standard procedures and DOE guideline requirements for release to unrestricted use.

SURVEY PROCEDURES

Verification activities were conducted in parallel with or immediately following remedial actions and post-remedial action monitoring, to minimize delays or interruptions in remedial action and restoration efforts. An ESSAP representative reviewed the post-remedial action monitoring data, conducted visual inspections, and performed independent radiological surveys. Independent measurements and sampling were typically performed in 10 to 50% of the total area remediated. The actual fraction of the remediated area selected for independent survey was area specific and was based on such factors as the historical use of radiological materials at the site, extent of decontamination required, and post-remedial action monitoring data. Based on findings as the work progressed, the scope of the survey was altered as necessary. Survey activities were conducted in accordance with current procedures in the ORISE ESSAP Survey Procedures Manual and a site specific survey plan.¹¹ Appendices A and B describes the survey and analytical instrumentation and procedures utilized by ESSAP.

Phase II verification activities were in the following locations:

<u>BUILDING</u>	<u>LOCATION</u>
1	Rooms 119 and 306
3	Rooms 101, 102 and 103
4	Rooms 103, 105, 106 and Exterior South Wall
5	Plumbing Shop, Machine Shop and South side exterior

17	Mens Room, Open Storage Area, Labs 10A and 10, Second Floor Storage Room, Second Floor Supply and Storage Room, Attic and Exterior
23	Basement, First Floor Crusher Room and Exterior East Wall, Roof, Thorium Room, Laboratory 1, Second Floor Crusher Room, Second Floor Storage Room
24	Rooms 103, 104, and 106
25	First Floor and Mezzanine
26	Room 103
28	Basement, Room 3, Hallway, Laboratories 13 and 15, and the Attic
29	Rooms 106, 109, 111 and 113
30	Fabrication Shop, West Mezzanine and the Machine Shop
31	Rooms 1A, 2 and 3, and the Attic
33	Rooms 103 and 104,
Exterior Areas	Lime Pits and adjacent areas, East of Building 27

Figures 3-159 show building floor plans and remediated areas

Reference Grid

Verification measurements and sampling locations were referenced to the existing BNI grid system, where possible. When necessary, a reference grid was established by ESSAP. The size of the grid blocks varied according to the size of the area remediated or the size of the room. Typically, the grid consisted of either 1 m² or 4 m² grid blocks. Grid blocks were established on floors and lower walls (up to 2 m) in areas designated for remediation. The upper walls, ceilings, and remediated areas of less than 10 m² were not gridded. Measurements made on these surfaces were referenced to prominent building features.

Surface Scans

Surfaces of selected remediated and surrounding areas were scanned in order to identify residual contamination. Indoor building surfaces and exterior surfaces and excavations were scanned for elevated direct gamma radiation levels and for alpha, and/or beta contamination, as appropriate. In some cases, areas were scanned up to 100%. Particular attention was given to cracks, beams, piping, ledges, ducts, drains, and other surfaces where material might settle or accumulate. Surface scans were performed using portable NaI(Tl) scintillation, gas proportional, ZnS scintillation, and/or GM detectors. All detectors were coupled to ratemeters-scalers with audible indicators. Areas of elevated direct radiation, identified by the scans, were brought to the attention of BNI for further investigation and, when necessary, remediation.

Surface Activity Measurements

One-hundred-and-seven grid blocks and 999 single-point alpha and/or beta surface activity measurements were performed within and adjacent to remediated areas. In gridded areas and at locations where elevated direct radiation was suspect, grid block measurements for total alpha and beta activity were systematically performed at the center and at four points, midway between the center and the grid block corners. For remediated areas smaller than 10 m² and upper walls and ceilings, single-point measurements for total activity were performed. Smear samples for removable alpha and beta activity were collected at the highest direct measurement location in each grid block and at single-point measurement locations. Refer to Figures 3 through 159 for measurement locations. Some of the remediated areas were scanned only, then verified by review of BNI post-remedial action survey measurements.

Exposure Rate Measurements

Gamma exposure rates were measured at 1 meter above surfaces, using a NaI(Tl) gamma scintillation detector, cross-calibrated with a pressurized ionization chamber (PIC). The cross-calibration data utilized had been developed for the ARC during the 1988 Phase I verification survey.

Soil Sampling

Soil samples were collected from 12 locations where remedial actions uncovered the underlying soils beneath floors, pits, or paved surfaces.

Miscellaneous Sampling

Miscellaneous brick and/or concrete samples were collected from 2 locations to verify that elevated direct radiation was due to the presence of naturally occurring radionuclides indigenous to certain construction materials.

Sample Analysis and Data Interpretation

Samples and direct measurement data were returned monthly to the Oak Ridge, TN laboratory for analysis and interpretation. Surface activity measurements and exposure rate measurements were converted to units of dpm/100 cm² and μ R/h, respectively. Smear samples were analyzed using a low background proportional counter to determine removable gross alpha and gross beta activity. Soil and building materials were analyzed by solid-state gamma spectrometry. The spectra were reviewed for thorium and uranium activity concentration levels as well as any other identifiable photopeaks. Surface activity levels and radionuclide concentrations in soil and concrete were compared to the generic residual radioactive materials guidelines specified in DOE Order 5400.5, which are summarized in Appendix C, or to the site-specific supplemental guidelines in areas of mixed Th-232 and U-238 contamination.¹²⁻¹⁶

FINDINGS AND RESULTS

DOCUMENT REVIEW

The documentation, prepared by BNI, adequately describes the procedures and results of the remediation and post-remedial action surveys. Data, presented in reports and supporting documents, provide an accurate description of the current radiological status of the facility.

SURFACE SCANS

Surface scans identified areas of residual elevated direct radiation in the following locations:

<u>BUILDING</u>	<u>LOCATION</u>
3	Room 101
4	Room 105 east and west pits
5	Exterior roof eaves
17	Second Floor Storage Room , North Truss
23	Lab 1-Trenches 1, 2, 4, 7, 17, 18, the North Floor and Wall, Crusher Room-the Conical Mill, Braun Pulverizer and Vent Pipe
24	Room 106
25	Mezzanine
28	Lab 13, Basement Floor and Equipment
30	Fabrication Room Floor and Equipment

BNI was notified of these locations so that additional remediation or other appropriate action could be performed, prior to final verification surveys.

SURFACE ACTIVITY LEVELS

The results of surface activity measurements, performed in Buildings 1, 3, 4, 5, 17, 23, 24, 25, 26, 28, 31, 33 and exterior locations, where Th-232 guidelines applied, are summarized in Table 1. The highest grid block averages for total activity were 240 dpm/100 cm² for alpha and 990 dpm/100 cm² for beta. Total activity levels for individual measurements ranged from < 62 to 630 dpm/100 cm² for alpha and < 410 to 10,000 dpm/100 cm² for beta. Removable activity levels ranged from < 6 to 200 dpm/100 cm² for gross alpha and < 13 to 110 dpm/100 cm² for gross beta.

Surface activity measurements collected from the portions of Buildings 17 and 28, where U-238 guidelines applied, are summarized in Table 2. These areas include Building 17, the floor of Lab 10, Attic and Second Floor Storage Rooms; and Building 28 first floor. The highest grid block averages for total activity in these locations were 210 dpm/100 cm² for alpha and 3100 dpm/100 cm² for beta. Total activity levels for individual measurements ranged from <62 to 920 dpm/100 cm² and <410 to 13,000 dpm/100 cm² for alpha and beta respectively. Removable activity ranged from <6 to 19 dpm/100 cm² for gross alpha and <13 to 16 dpm/100 cm² for gross beta.

Supplemental guidelines were requested by BNI where Th-232 and U-238 were present as co-contaminants¹¹⁻¹⁵. The development of these area-specific guidelines was based on the ratios of the relative levels in each area of Th-232 and U-238. Four different sets of supplemental guidelines were requested in these situations. The locations where each set were applied and the respective measurement data follows.

Surface activity measurements for Building 17, Lab 10 (excluding the floor) and Building 30, Fabrication Room are summarized in Table 3. The highest grid block averages were 990 dpm/100 cm² for alpha and 1600 dpm/100 cm² for beta. Total activity levels for individual measurements ranged from <62 to 1900 dpm/100 cm² and <410 to 75,000 dpm/100 cm² for alpha and beta respectively. Removable activities ranged from <6 to 180 dpm/100 cm² for gross alpha and <13 to 170 dpm/100 cm² for gross beta.

Surface activity measurements for Building 31 Attic are summarized in Table 4. The range of surface activity measurements were <62 to 640 dpm/100 cm² and <410 to 2500 dpm/100 cm² for alpha and beta respectively. Removable activity ranged from <6 to 17 dpm/100 cm² for gross alpha and <13 to 16 dpm/100 cm² for gross beta.

The third location where supplemental guidelines were requested was for Building 28, Basement Sump Pit #12. Measurements are summarized in Table 5. The grid block average was <62 dpm/100 cm² for alpha and 500 dpm/100 cm² for beta. Total activity levels for individual measurements ranged from <62 dpm/100 cm² and <410 to 820 dpm/100 cm² for alpha and beta respectively. Removable activity was less than the detection sensitivity of the procedure, which is <6 dpm/100 cm² for gross alpha and <13 dpm/100 cm² for gross beta.

The Lime Pits supplemental guidelines combined both residual soil concentration guidelines and surface activity guidelines. Surface activity levels, which were based on the presence of both Th-232 and U-238, were utilized for the pit walls from grade level to 15 cm below grade. The concrete surfaces greater than 15 cm below grade had deteriorated; therefore, Th-232 concentration levels in the concrete were compared to the soil concentration guidelines to determine whether or not remedial objectives had been met as the pits were back-filled with clean soil. The radionuclide concentrations in a composite concrete sample from the lime pits are provided in Table 6. The sample contained 0.7 pCi/g, 0.6 pCi/g and 4.2 pCi/g of Ra-226, Th-232 and U-238 respectively. BNI's post-remedial action survey data was reviewed by ESSAP to verify the radiological status of the lime pits from grade level to 15 cm below grade.

EXPOSURE RATE MEASUREMENTS

The average area background exposure rate was approximately 9 μ R/h. Exposure rates ranged from 4 to 16 μ R/h.

RADIONUCLIDE CONCENTRATIONS IN SOIL

Concentrations of Ra-226, Th-232, and U-238 in soil and concrete samples collected from remediated areas within Buildings 4, 5, 17 and 26 and exterior locations adjacent to Buildings 5, 27, 30/31 and the lime pits are presented in Table 6. Concentrations ranged from 0.4 to 1.1 pCi/g for Ra-226, 0.5 to 3.3 pCi/g for Th-232, and <2 to 11.6 pCi/g for U-238. Background soil concentrations for the Albany area, as determined during the Phase I verification survey are 0.5 to 1.3 pCi/g, 0.3 to 2.0 pCi/g and 0.3 to 1.0 pCi/g for Ra-226, Th-232 and U-238 respectively.

COMPARISON OF SURVEY RESULTS WITH GUIDELINES

The DOE surface contamination guidelines for residual radioactive material at a FUSRAP site are provided in Appendix C. The primary contaminant on building and equipment surfaces at ARC is Th-232, with localized presence of U-238. Th-232 and U-238 and associated daughter products emit both alpha and beta radiations. As rough, porous or dirty surfaces attenuate alpha radiation, the beta

activity was considered to be most representative of surface activity and used for comparison to guideline levels. The generic guidelines for Th-232 are as follows:

1000 dpm/100 cm², averaged over 1 m² area
3000 dpm/100 cm², maximum in a 100 cm² area
200 dpm/100 cm², removable

The generic DOE guidelines for residual U-238 surface activity are:

5,000 α dpm/100 cm², averaged over a 1 m² area
15,000 α dpm/100 cm², maximum in an 100 cm² area
1,000 α dpm/100 cm², removable

The generic DOE guidelines for Ra-226, Ra-228, Th-230, and Th-232 in soil are as follows:

5 pCi/g averaged over the first 15 cm of soil
 below the surface
15 pCi/g averaged over 15 cm thick layers of soils
 more than 15 cm below the surface

Soil guidelines for uranium are developed by DOE on a site specific basis. There has not been a uranium soil guideline derived for ARC. Site specific uranium guidelines developed for other FUSRAP sites have typically ranged from 30 to 90 pCi/g.

The generic DOE gamma exposure rate guideline is as follows:

The average level of gamma radiation inside a building or habitable structure on a site to be released for unrestricted use shall not exceed the background level by more than 20 μ R/h and shall comply with the basic dose limit when an appropriate use case scenario is considered.

The supplemental guidelines and the applicable areas are as follows:

Building 17, Lab 10 (excluding the floor) and Building 30, Fabrication Room

4,000 dpm/100 cm², averaged over a 1 m² area
12,000 dpm/100 cm², maximum in an 100 cm² area
800 dpm/100 cm², removable
200 dpm/100 cm², removable Building 17, Lab 10*

*Note: Sample analysis of removable materials collected by BNI during remedial actions identified Th-232 as the sole contaminant in the removable materials in Building 17, Lab 10. Miscellaneous materials such as paint, where fixed activity was identified, were also sampled by BNI. These samples contained primarily U-238 with lesser amounts of Th-232. Therefore Th-232 removable contamination guidelines and supplemental fixed contamination guidelines were applied in Lab 10.

Building 31, Attic

2,500 dpm/100 cm², averaged over a 1 m² area
7,500 dpm/100 cm², maximum in a 100 cm² area
500 dpm/100 cm², removable

Building 28, Basement Pit #12

1600 dpm/100 cm², averaged over a 1 m² area
4,800 dpm/100 cm², maximum in a 100 cm² area
320 dpm/100 cm², removable

Lime Pits- (0-15 cm depth)

3,000 dpm/100 cm², averaged over a 1 m² area

9,000 dpm/100 cm², maximum in a 100 cm² area

600 dpm/100 cm², removable

Lime Pits- greater than 15 cm below ground level-soil guidelines

Th-232

15 pCi/g averaged over 15 cm thick layers of concrete
more than 15 cm below the surface

Several areas surveyed, where grid block measurements were not performed, have single-point direct measurement activity which exceed the applicable average guideline for a 1 m² area, but are less than the maximum allowable activity per 100 cm². Further investigation of these areas determined that the average activities across contiguous 1 m² areas were within release criteria. These locations include the following: Building 4 - Room 103 Drains, Room 105 East and West Pits; Building 5 - Machine Shop South Wall Conduit; Building 17 - Mens Room Valve Pit, Lab 10 Electrical Panel; Building 23 - Lab 1 Trench #'s 6, 7, 13 and Upper North Wall; Building 28 - Basement Sump Pit #3, Lab 13 Floor; Building 30 - Fabrication Shop Portable Rolling Mill #39974; Building 33 - Room 104 Floor.

ARC site locations, which remain in excess of the DOE guidelines, are summarized in Table 7 and are discussed below. The following locations have been included in a hazard assessment addendum issued by BNI: Building 23 - Lab 1, Trenches #1, 2 and 18 (beneath Lab 2), pipe protruding into Trench #7; Building 28 - Basement, Sump Pit #4 Pipe; Building 30 - Fabrication Room HPM Hydraulic Press #34469, Lindberg Furnace #40424, Machine Shop Baldwin Press #34768 (Figure Nos. 58, 59, 64, 72, 102, 134, 140, 145).^{9,15}

In the Building 23 Crusher Room, several unsuccessful attempts were made to remediate the Conical Mill #38563. As a result, small areas of elevated fixed beta activity, up to 6200 dpm/100 cm², remain on the unit (Figure 51). Additionally, an overhead vent pipe (Figure 50), associated with the Conical Mill, had elevated beta activity, up to 10,000 dpm/100 cm², on the internal surfaces. Due

to the potential for recontamination of these surfaces from ongoing licensed activities, the ARC site representative accepted the restoration as is.

With the exception of the previously discussed (Table 7) Building 23 trenches, pipes, and Crusher Room equipment; Building 28 sump pit; and Building 30 equipment, all other final verification survey surface activity levels were within generic or supplemental DOE guidelines for release without radiological restrictions.

Soil and/or concrete samples collected from excavations and areas, which exhibited elevated contact radiation, showed radionuclides were at acceptable release concentrations.

SUMMARY

ORISE's Environmental Survey and Site Assessment Program performed independent verification activities between September 1990 and April 1991 at the Albany Research Center in Albany, Oregon during the Phase II remedial actions. Verification activities included document and data reviews, surface scans, direct surface activity measurements, and soil and miscellaneous material sampling.

The generic DOE surface contamination guidelines, for most remediated areas, were those for thorium and uranium. Hazard assessments or supplemental limits were applied, respectively, when remediation was not feasible or when thorium and uranium were present as co-contaminants.^{8,9,12-16}

The documentation reviewed and data collected by ESSAP indicates that the radiological status of the buildings and outdoor areas was accurately described, and that the remedial objectives and generic guidelines or supplemental limits have been met.

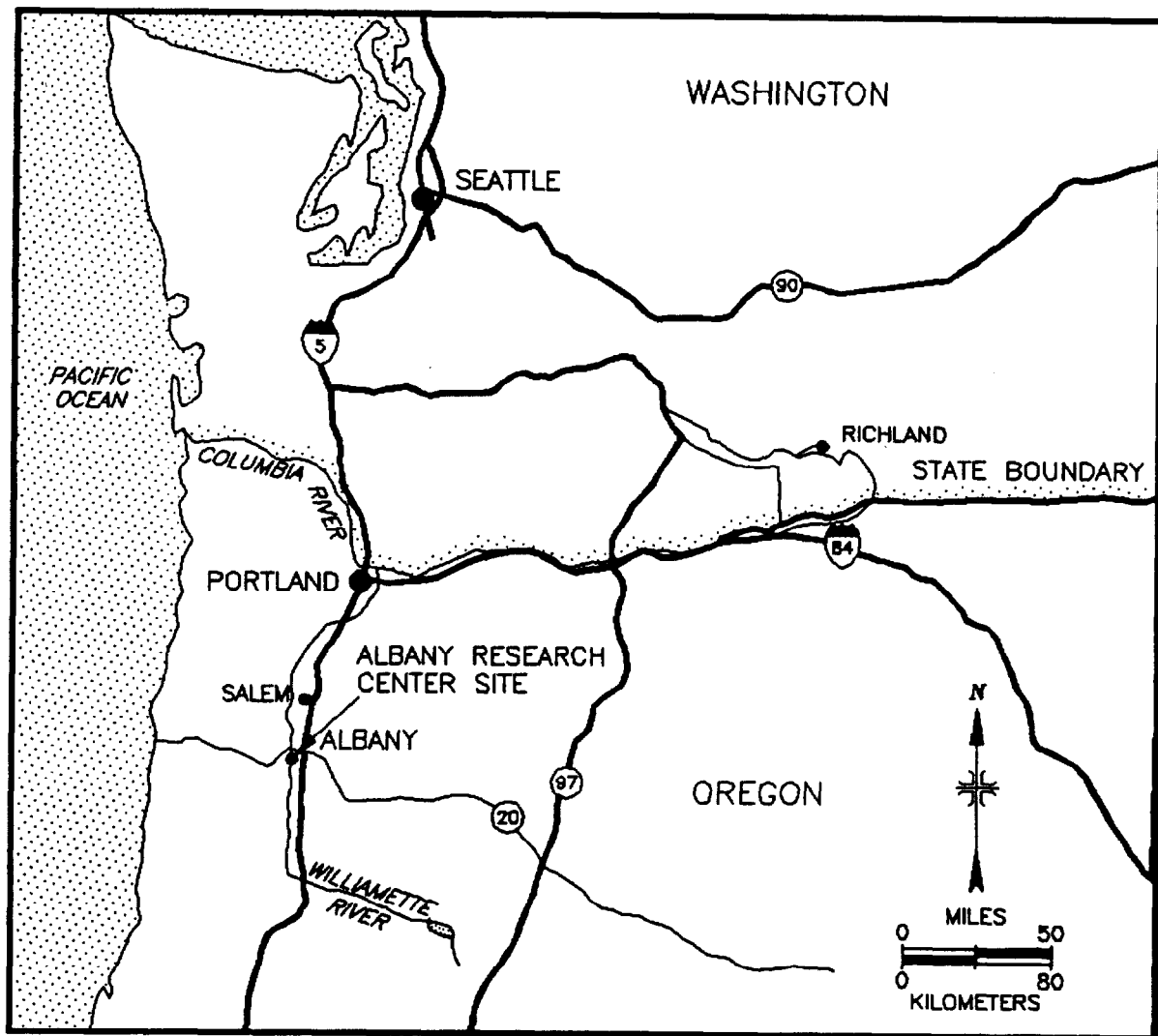


FIGURE 1: Location of the Albany Research Center

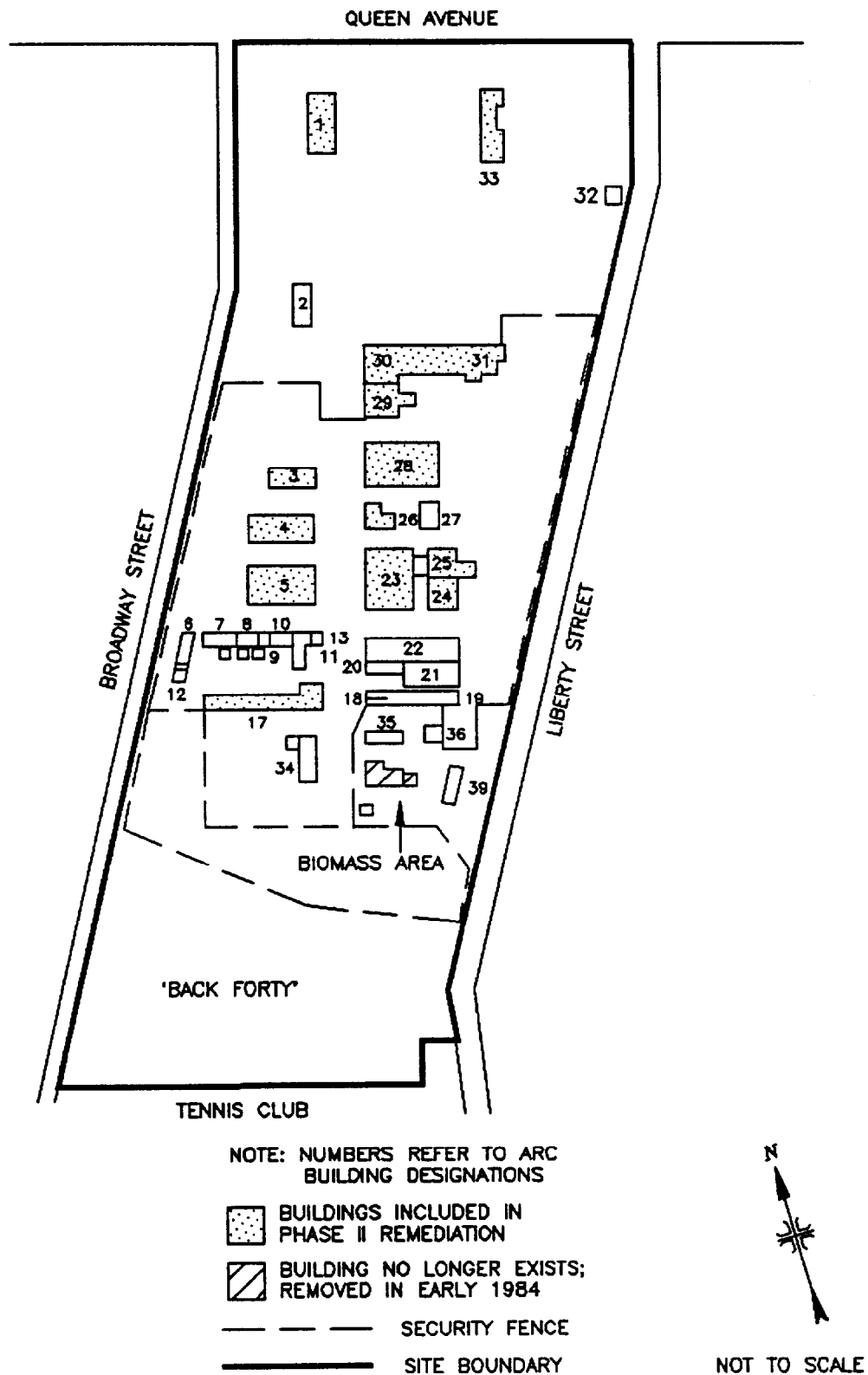


FIGURE 2: Plot Plan of the Albany Research Center

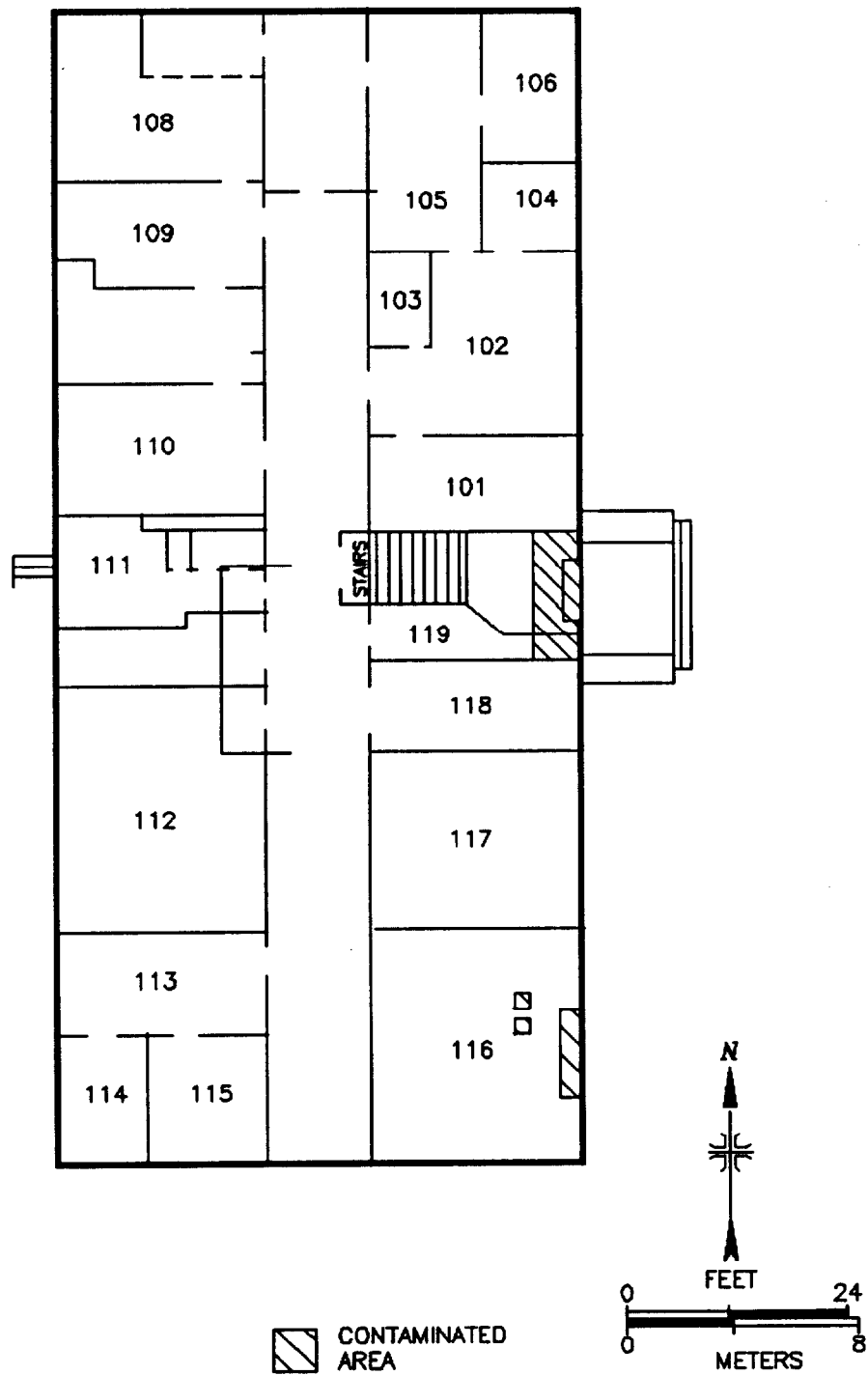


FIGURE 3: Plot Plan of Building 1, First Floor

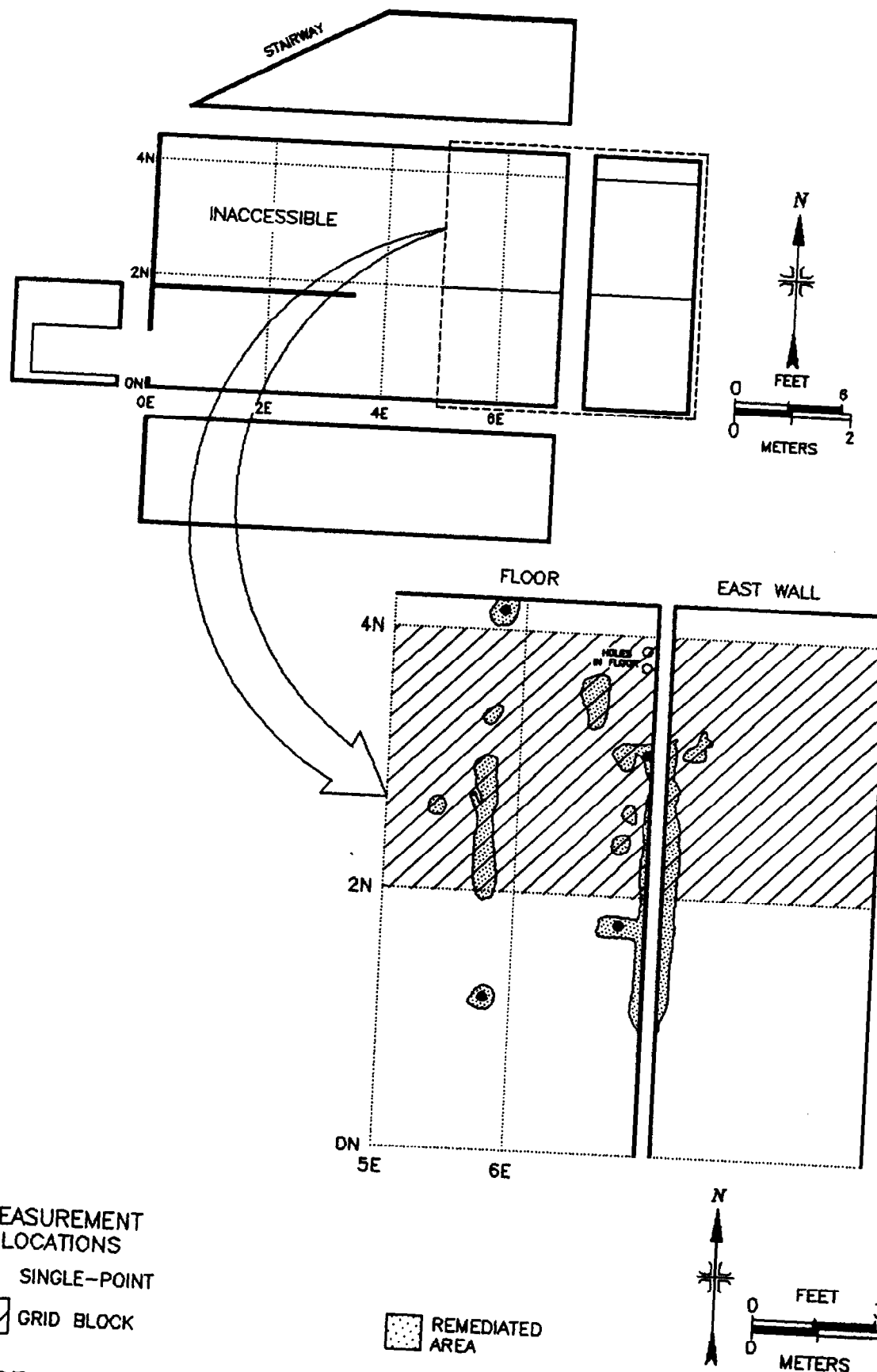


FIGURE 4: Building 1, Room 119 – Measurement Locations on the Floor and East Wall

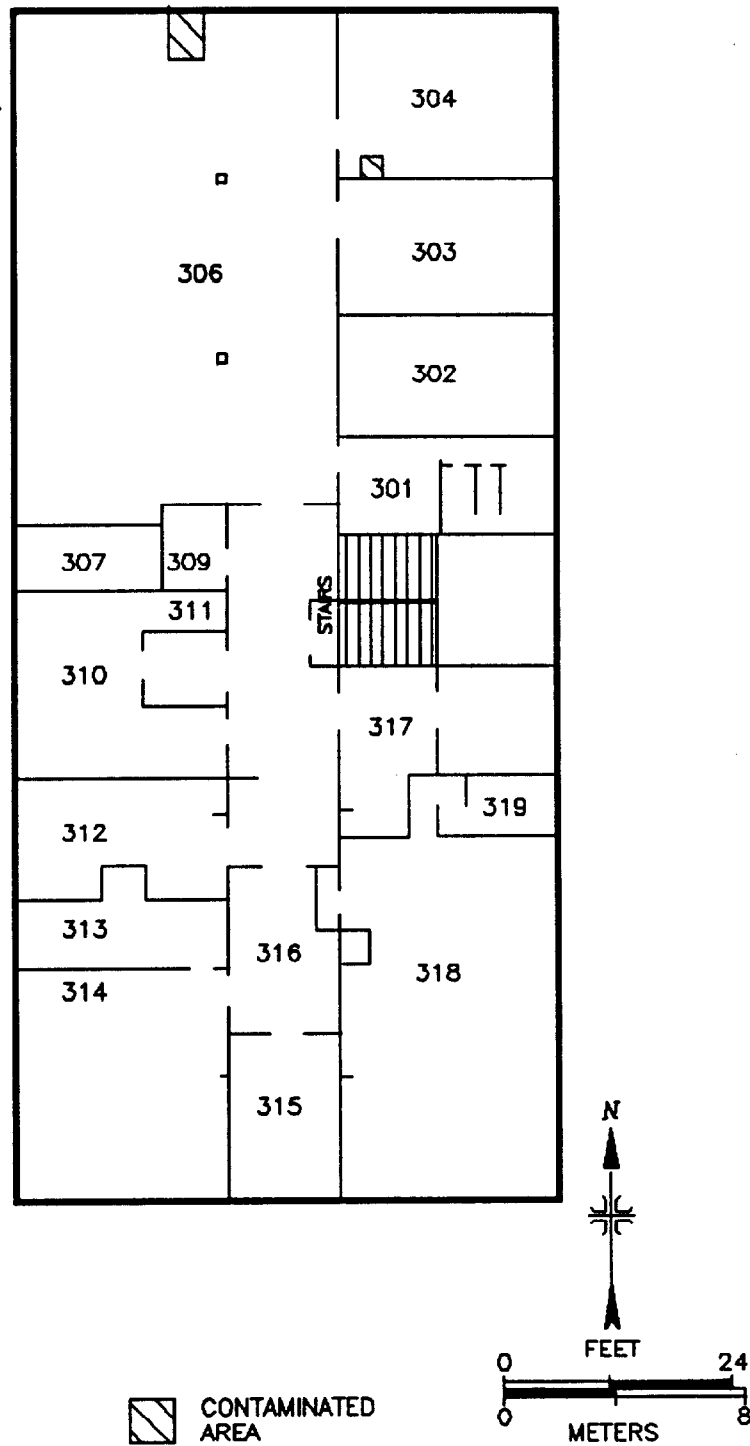


FIGURE 5: Plot Plan of Building 1, Third Floor

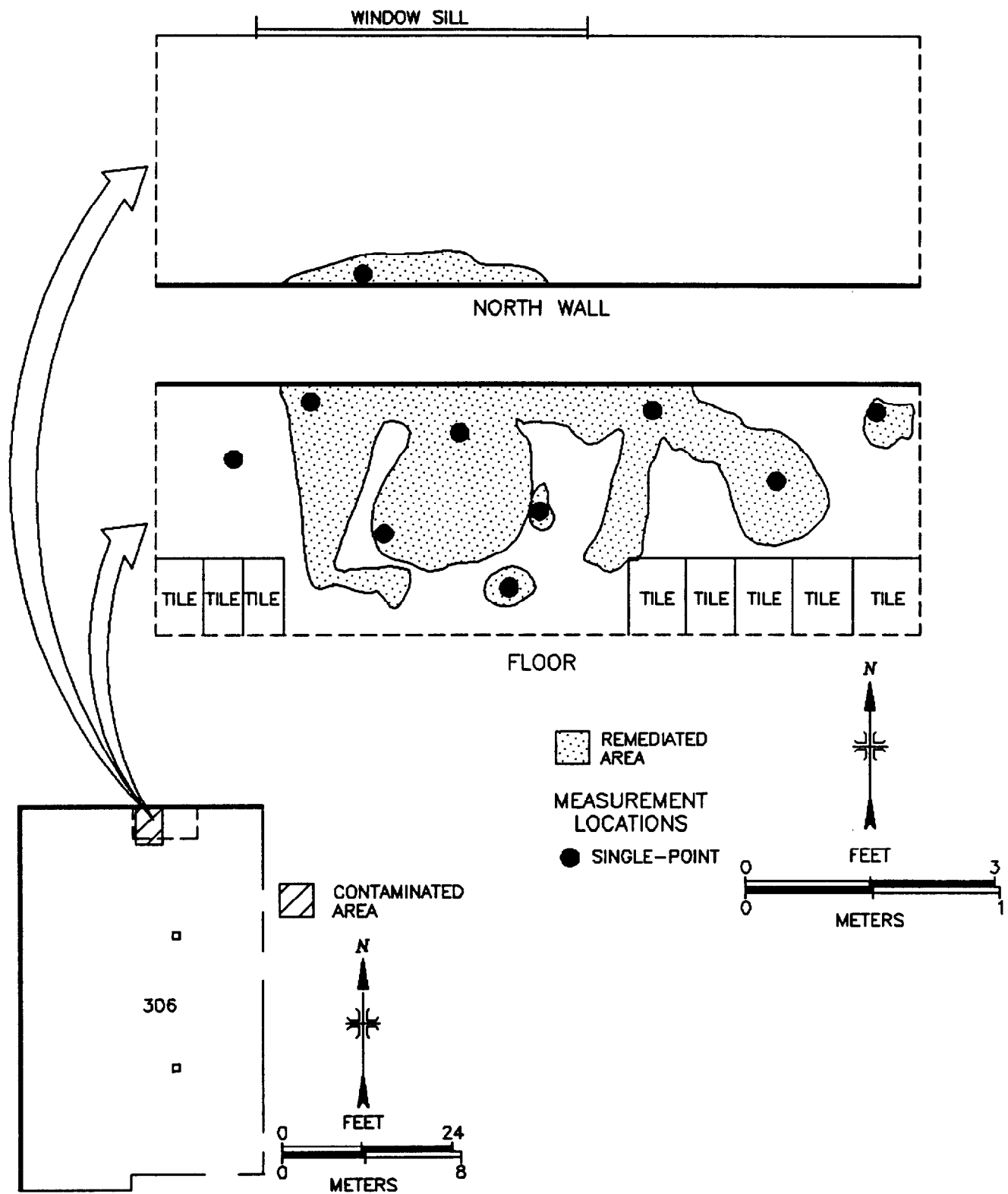


FIGURE 6: Building 1, Room 306 Floor and North Wall – Remediated Areas and Measurement Locations

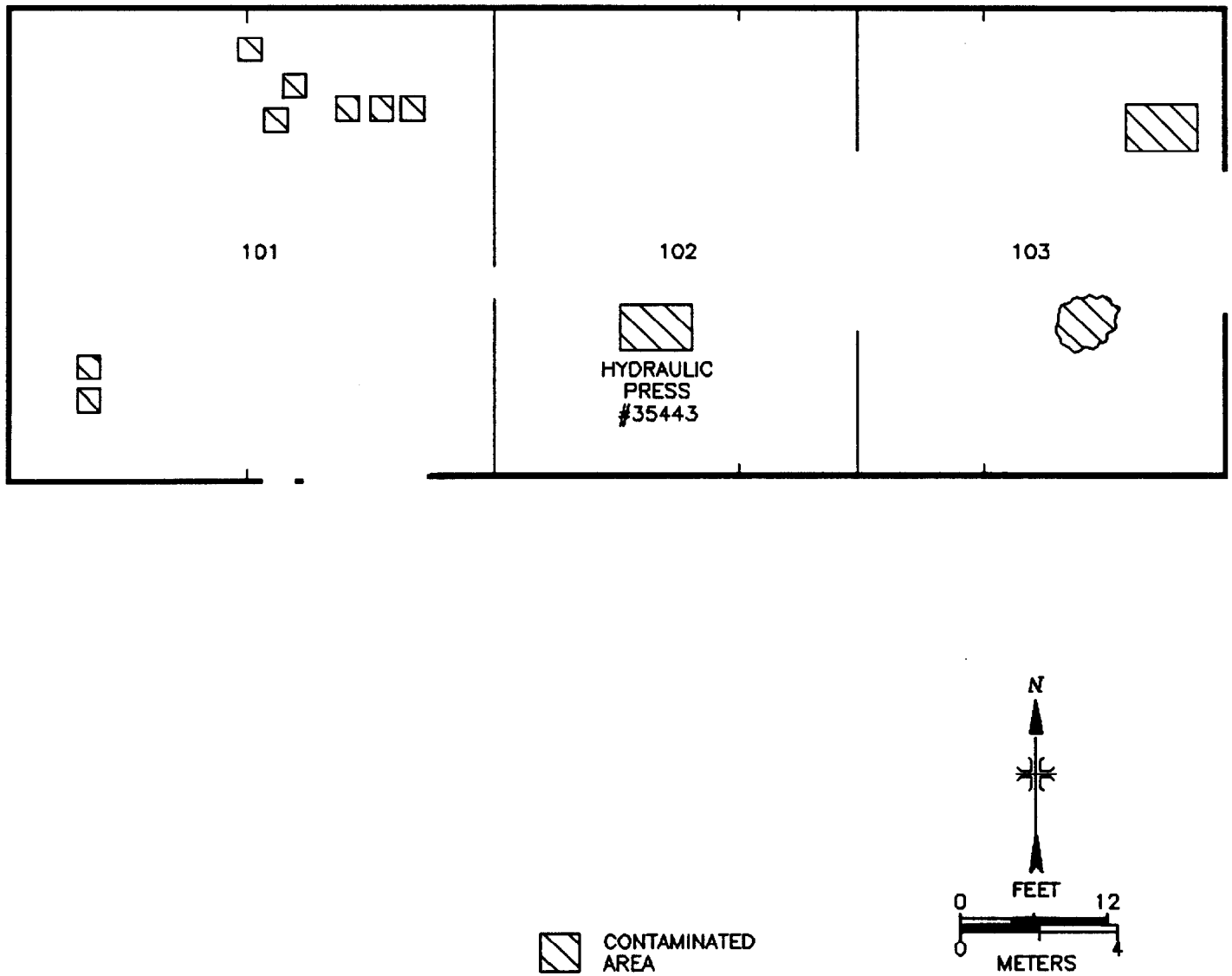


FIGURE 7: Building 3 Plot Plan

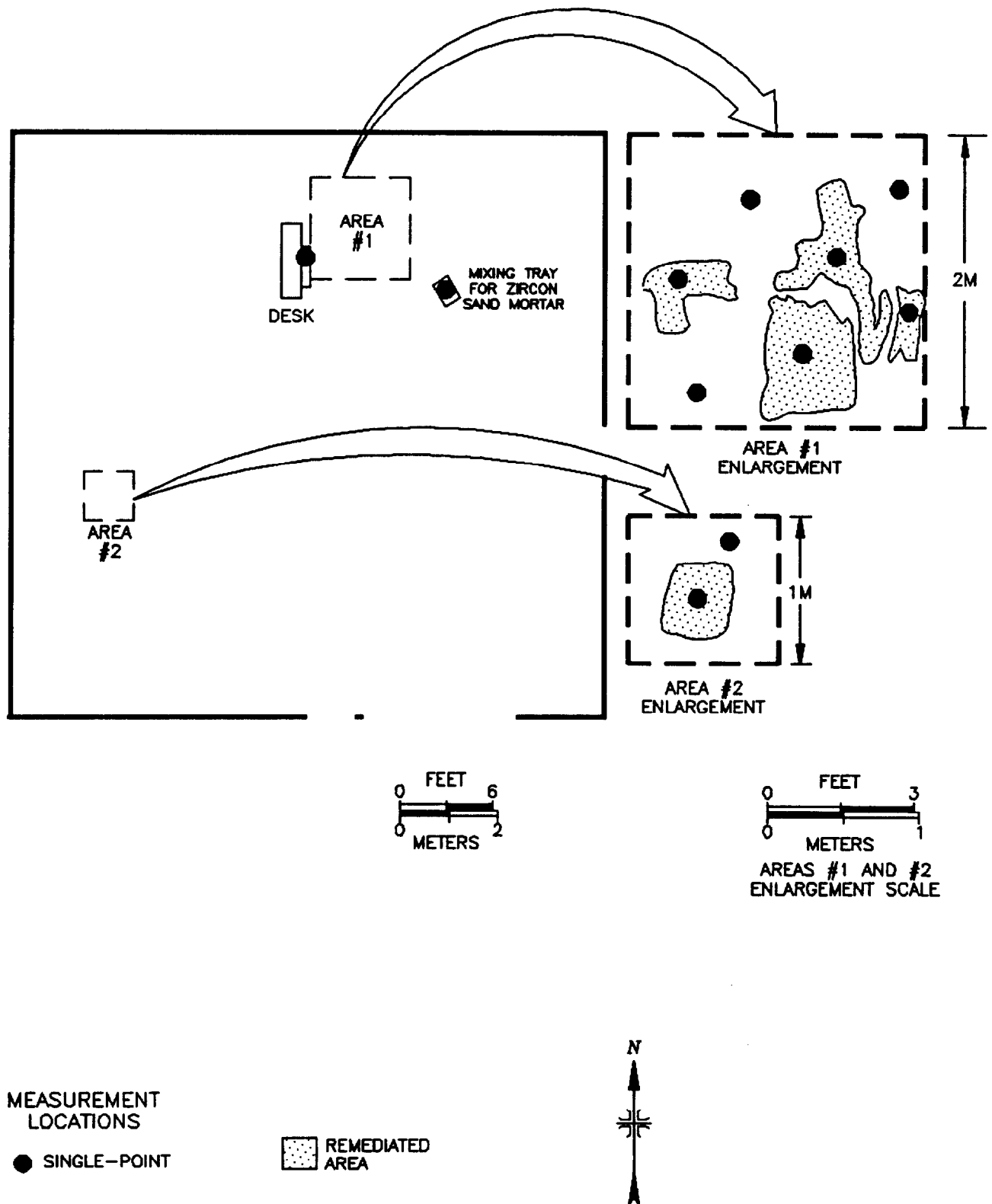


FIGURE 8: Building 3, Room 101 – Remediated Areas and Measurement Locations

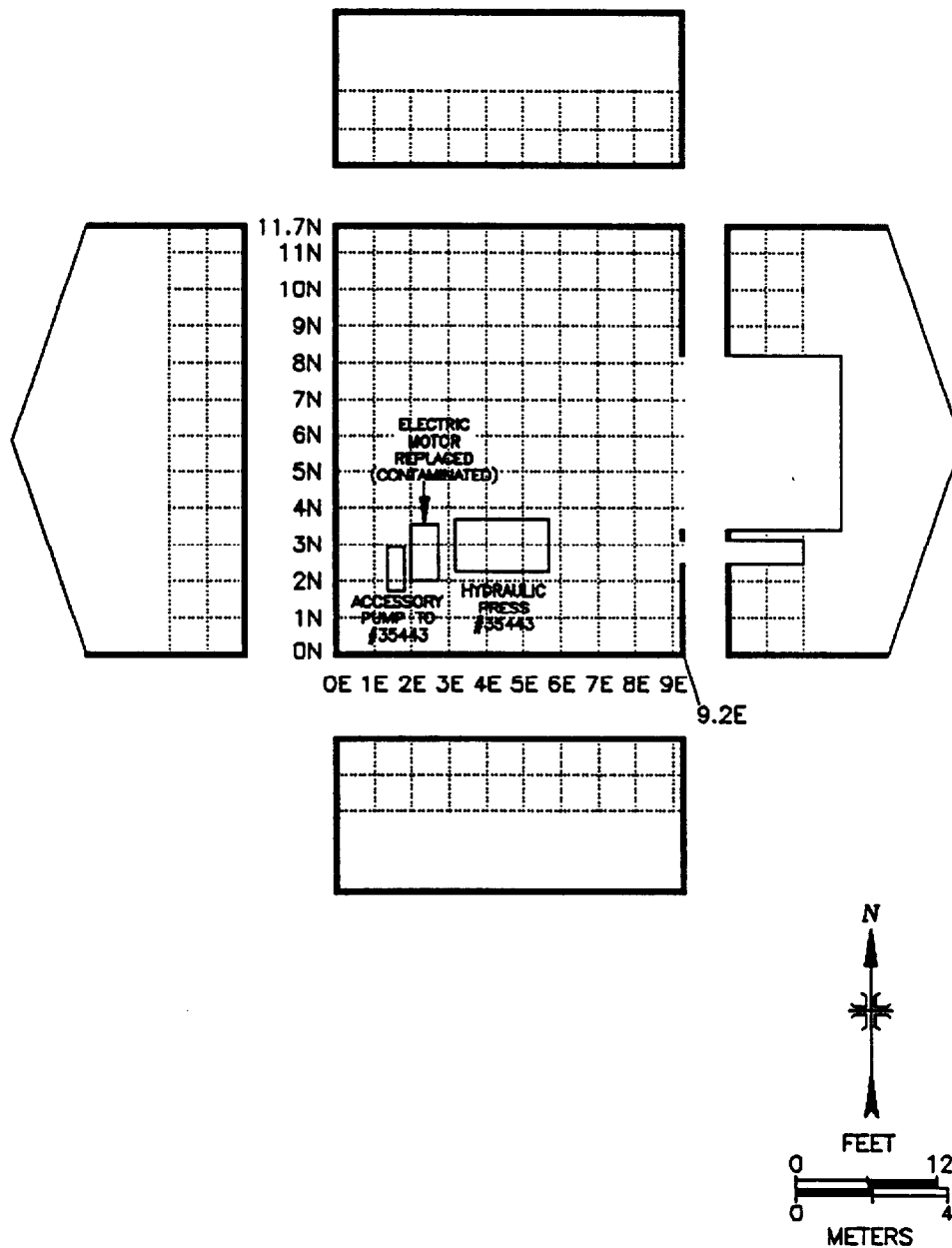


FIGURE 9: Building 3, Room 102 – Location of Hydraulic Press #35443

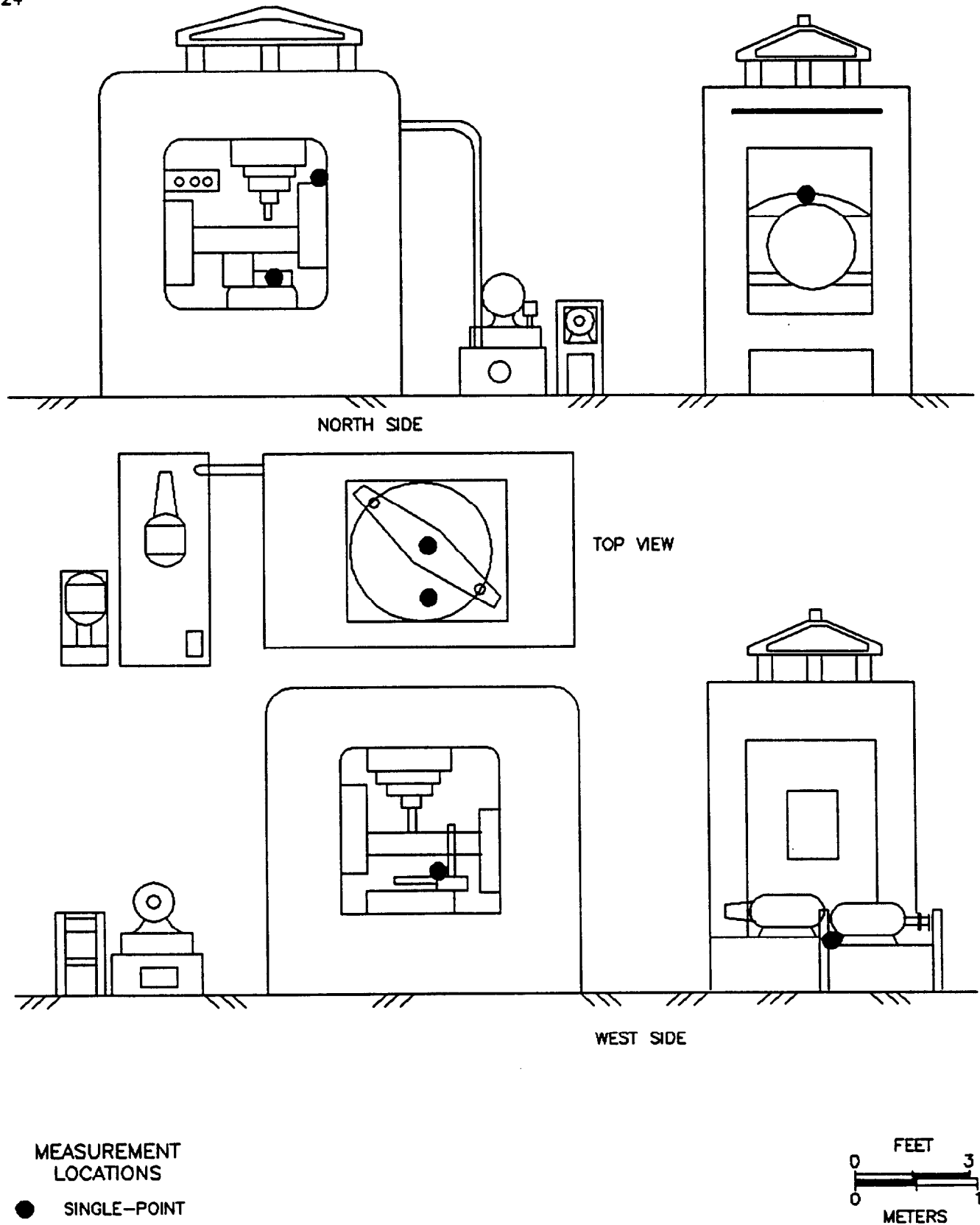


FIGURE 10: Building 3, Room 102, Hydraulic Press #35443 – Measurement Locations

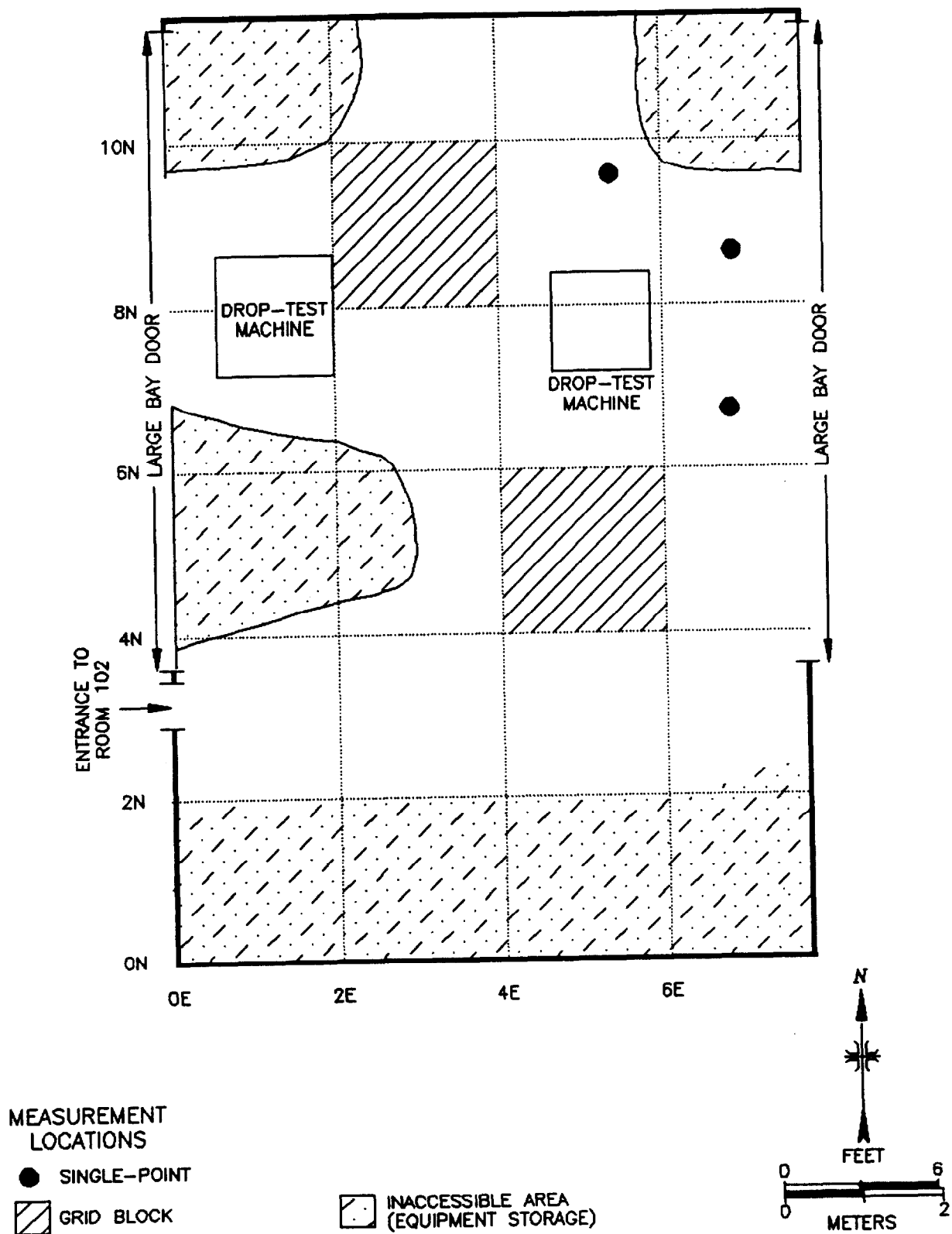


FIGURE 11: Building 3, Room 103 Floor – Measurement Locations

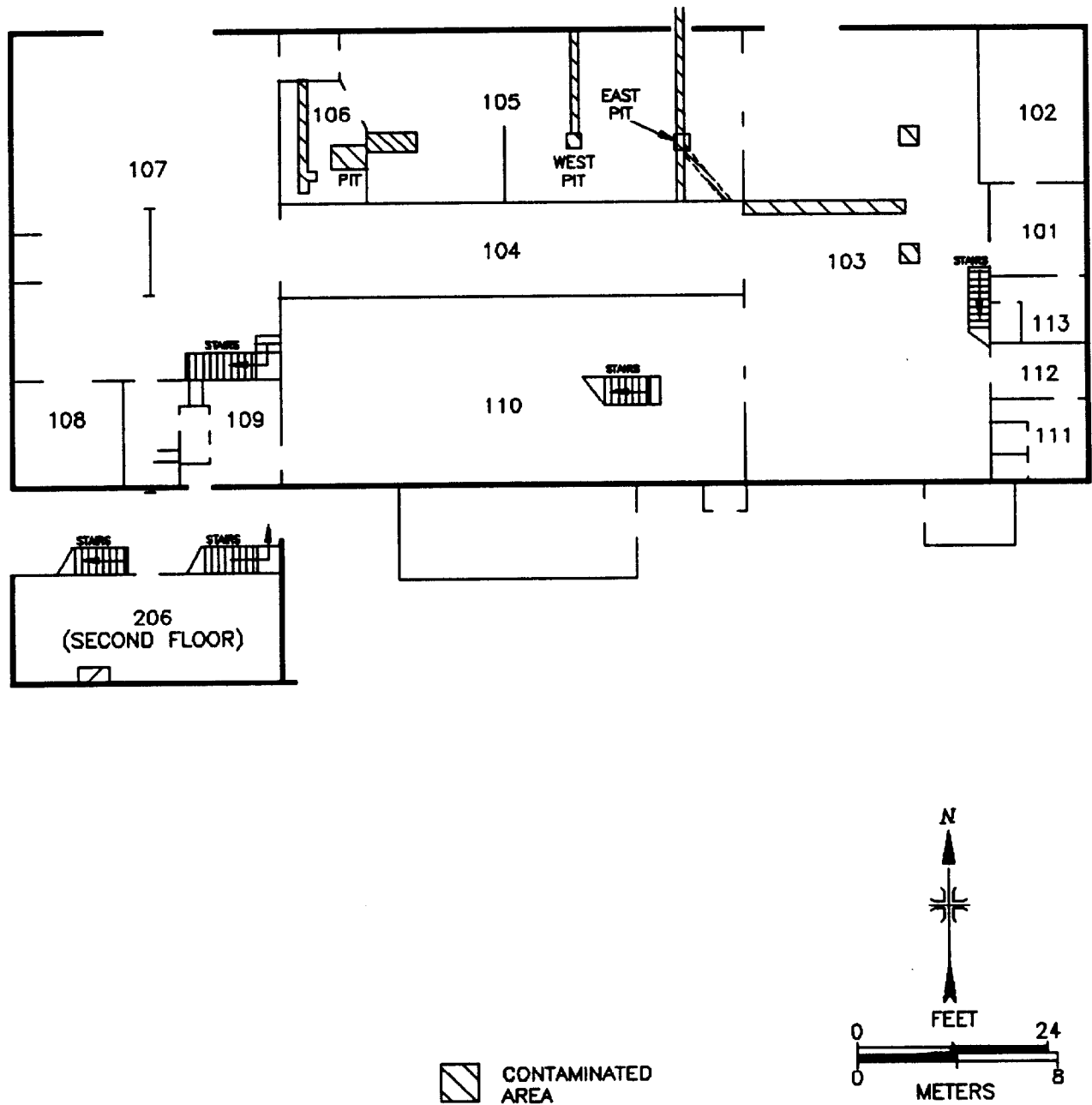


FIGURE 12: Building 4 Plot Plan, First and Second Floors

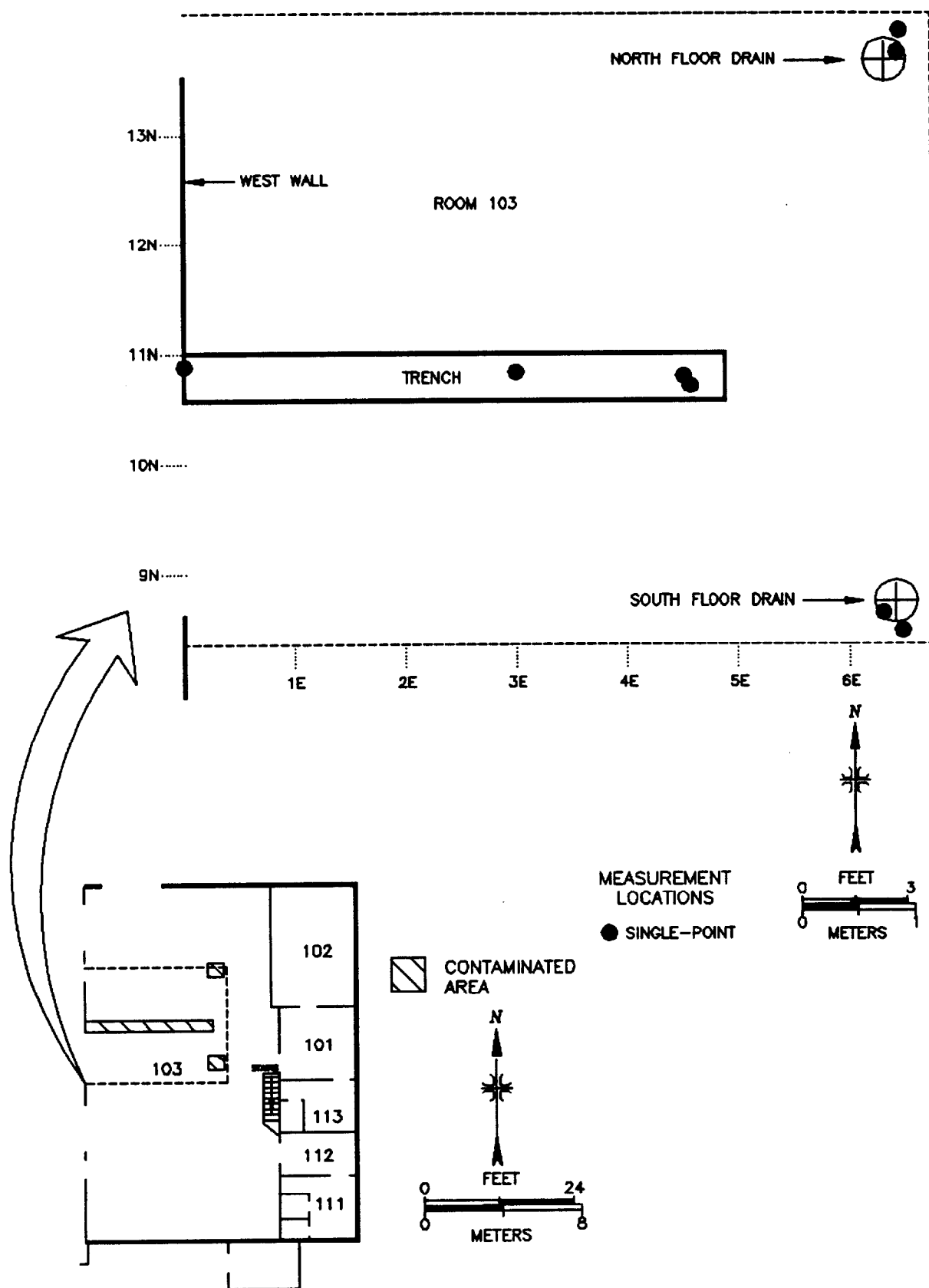
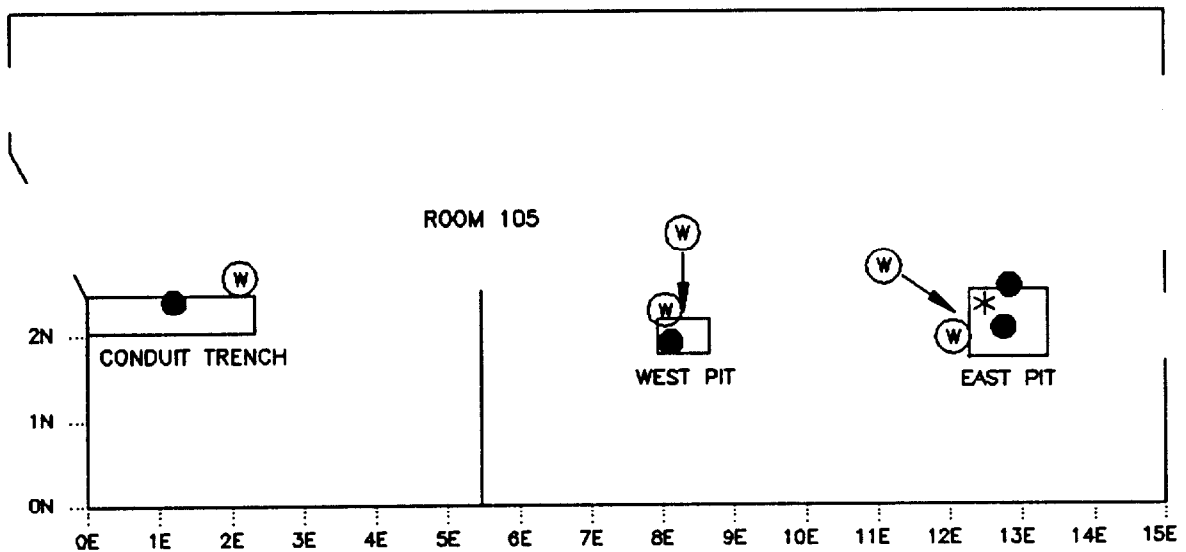


FIGURE 13: Building 4, Room 103 – Measurement Locations



- SAMPLING LOCATION**
- * SOIL SAMPLE
- MEASUREMENT LOCATIONS**
- SINGLE-POINT FLOOR
- ⊙ SINGLE-POINT TRENCH WALL

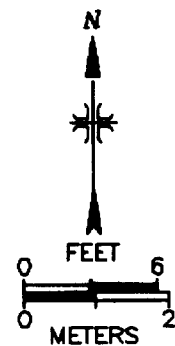


FIGURE 14: Building 4, Room 105 – Measurement and Sampling Locations

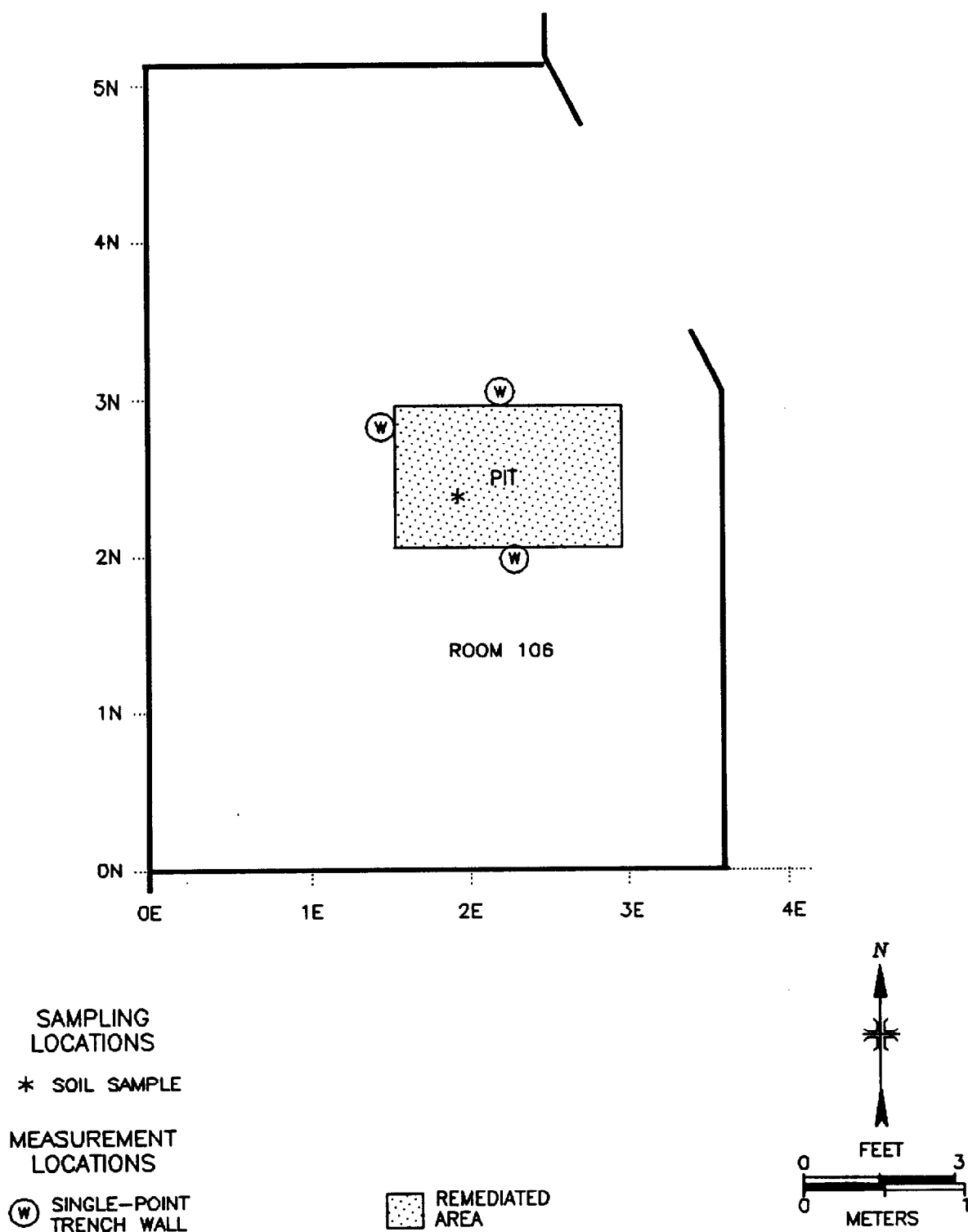


FIGURE 15: Building 4, Room 106 Pit – Measurement and Sampling Locations

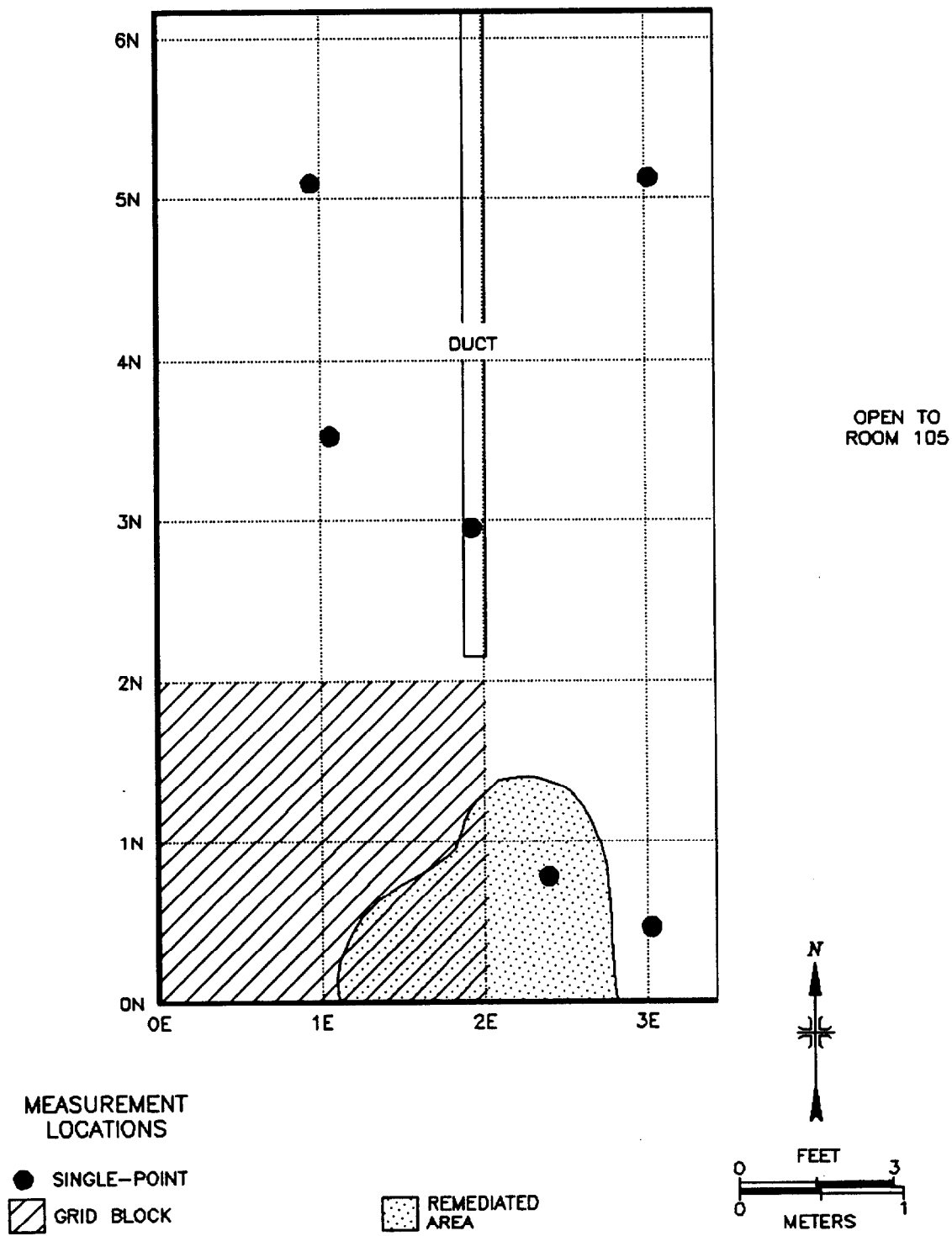


FIGURE 16: Building 4, Room 106 Mezzanine – Remediated Areas and Measurement Locations

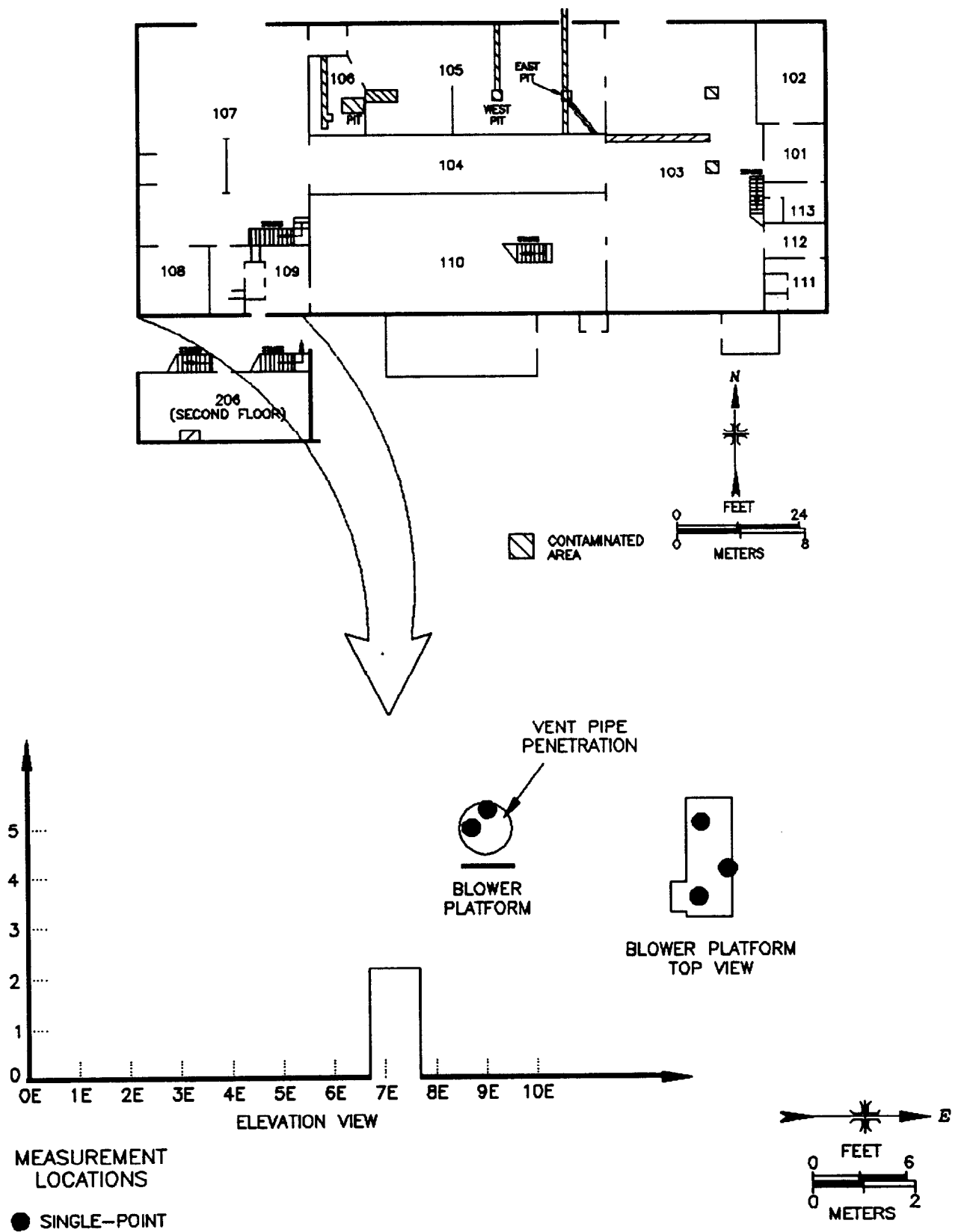


FIGURE 17: Building 4, Outside South Wall, Blower Platform – Measurement Locations

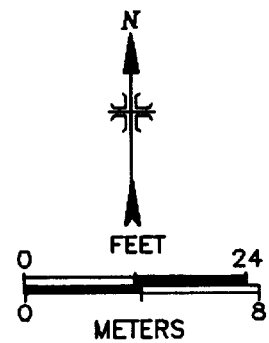
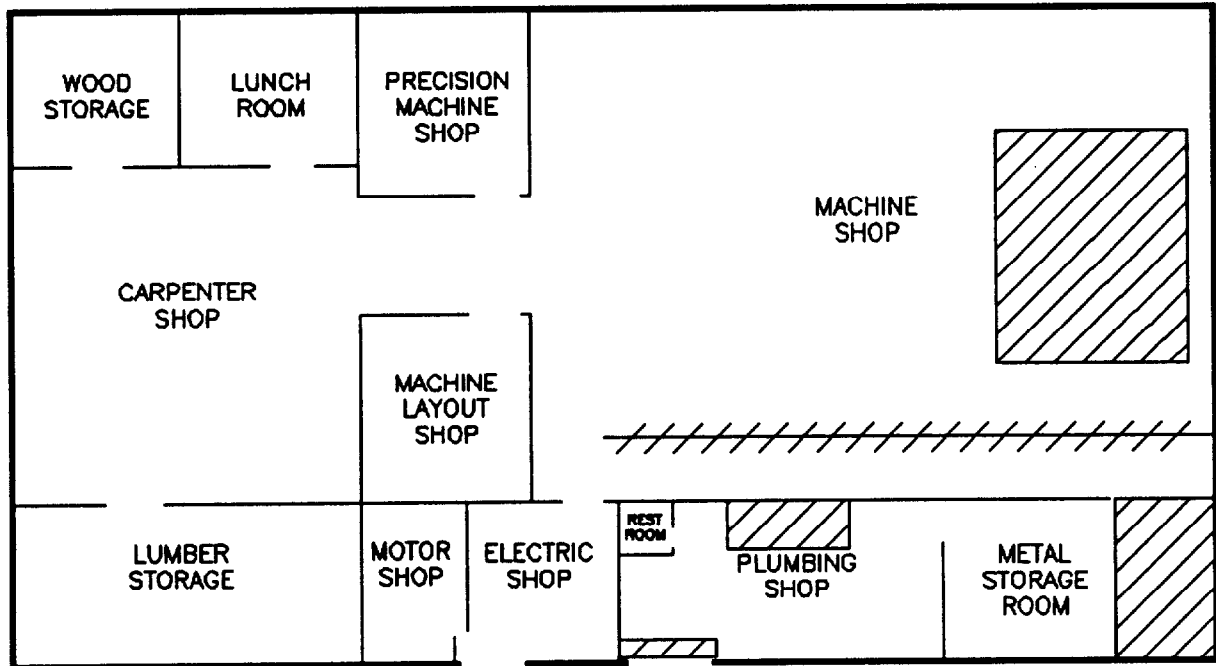


FIGURE 18: Building 5 Plot Plan

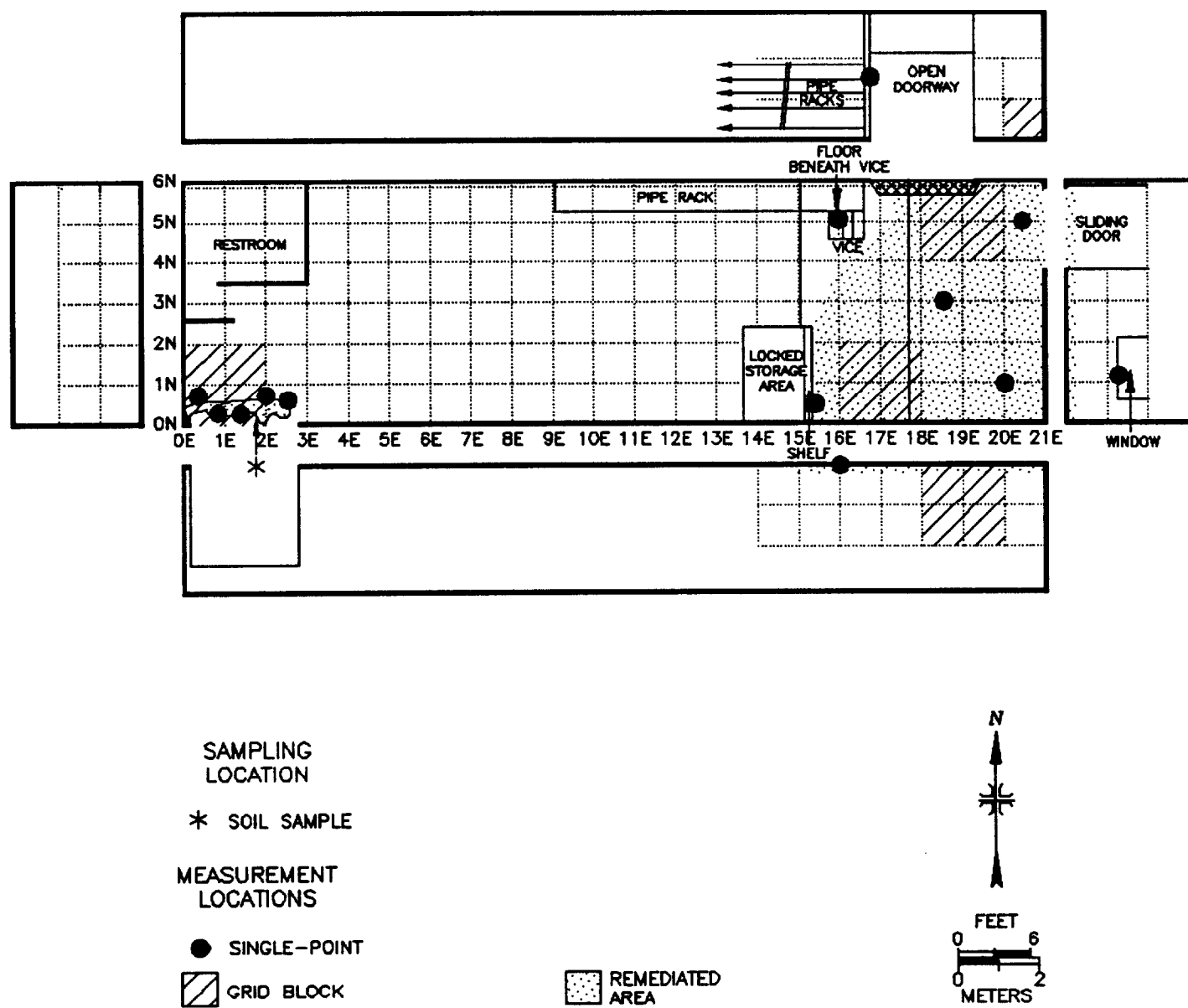


FIGURE 19: Building 5, Plumbing Shop Floor and Lower Walls – Remediated Areas and Measurement and Sampling Locations

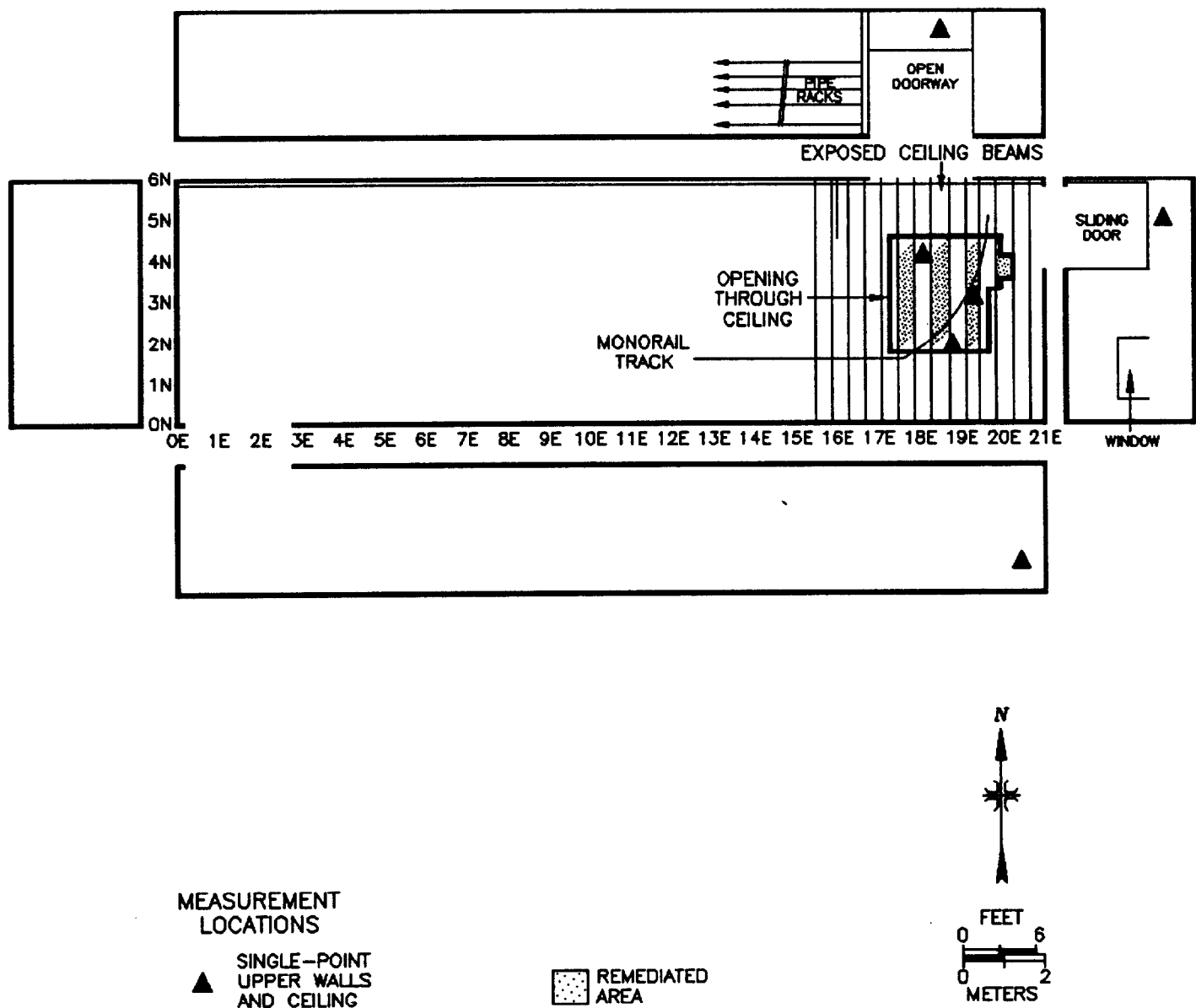


FIGURE 20: Building 5, Plumbing Shop Ceiling and Upper Walls – Remediated Areas and Measurement Locations

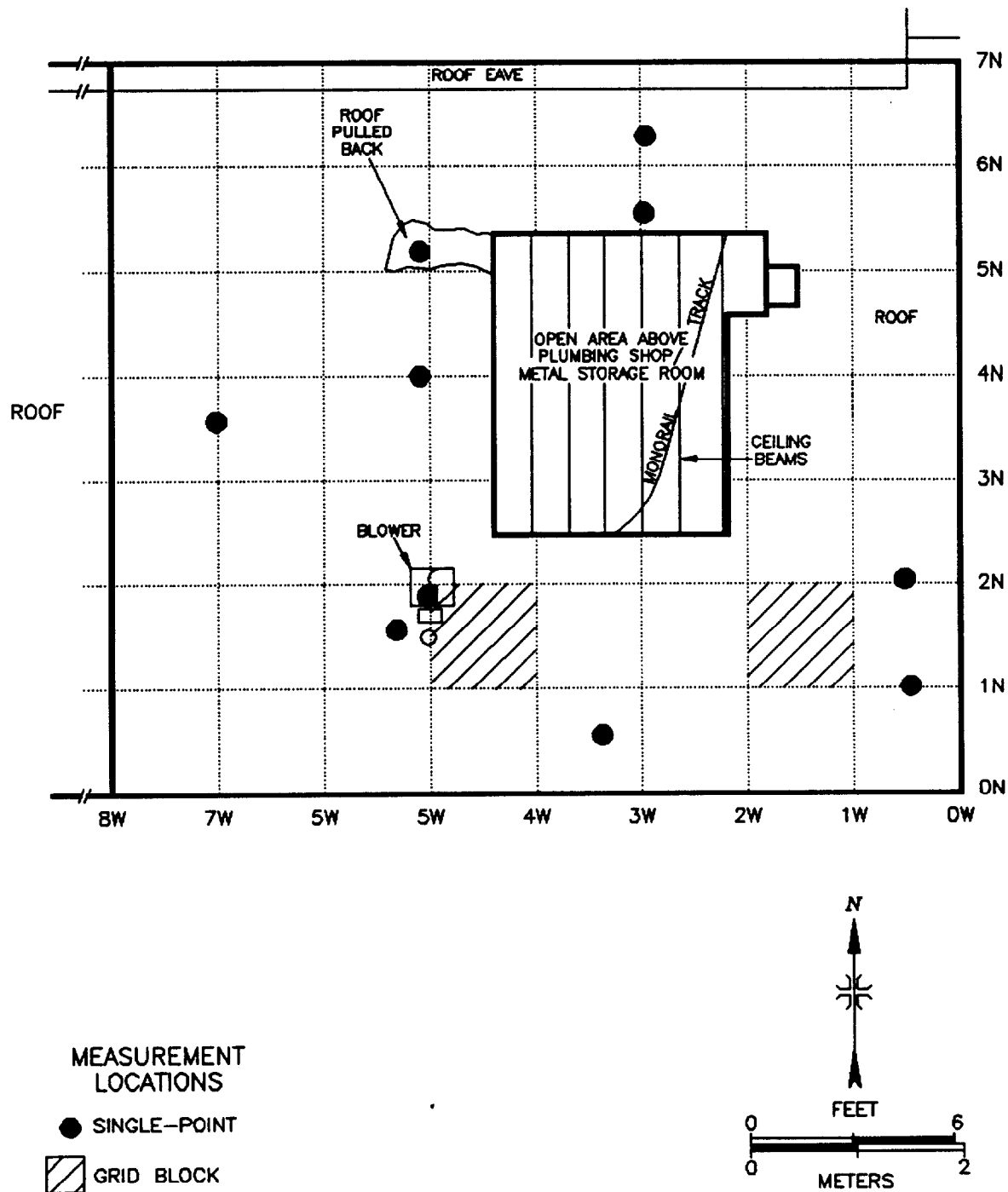


FIGURE 21: Building 5, Roof, Southeast Corner Above Plumbing Shop/Metal Storage Room – Measurement Locations

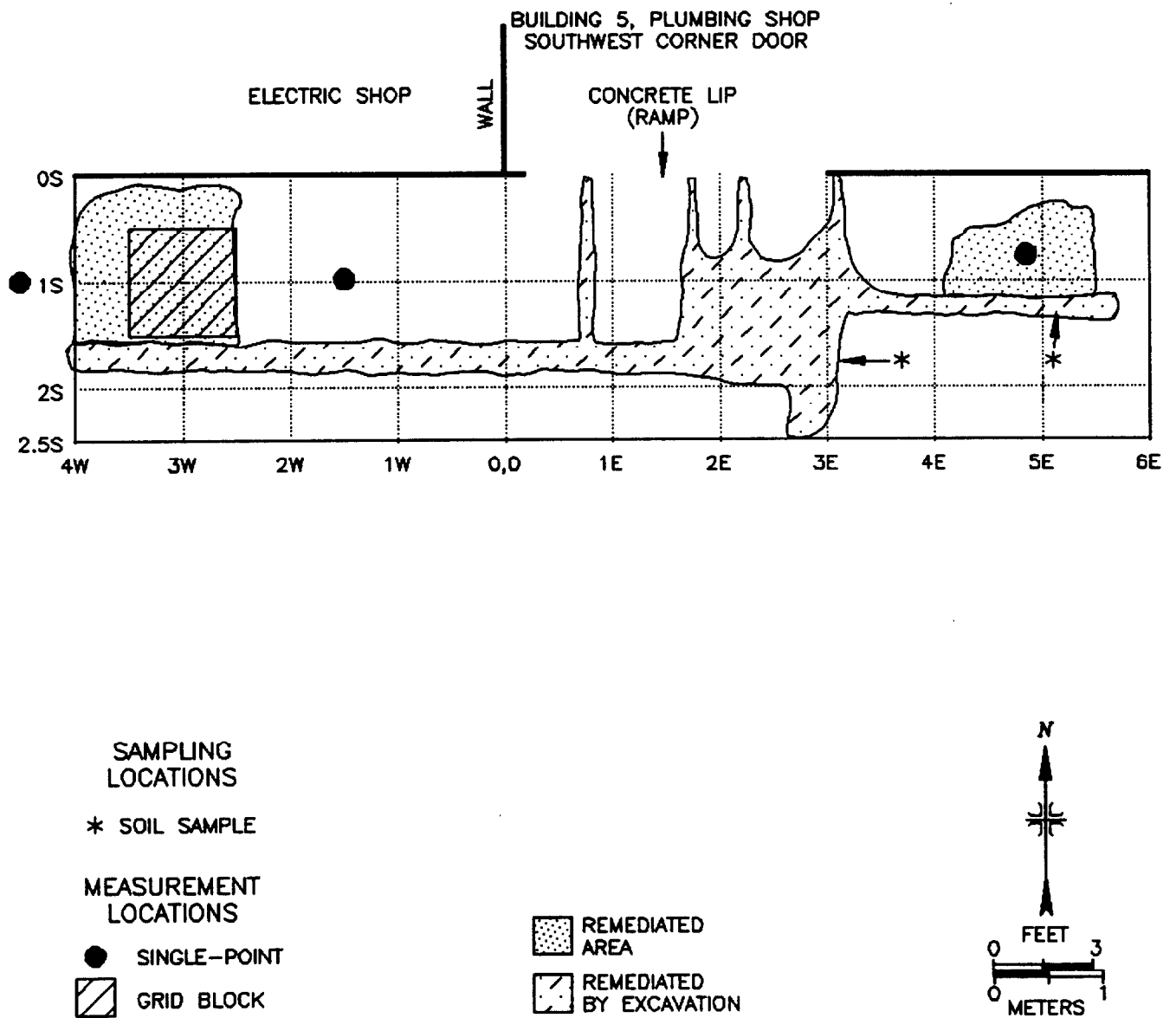


FIGURE 22: Building 5, Exterior of Plumbing Shop – Remediated Areas and Measurement and Sampling Locations

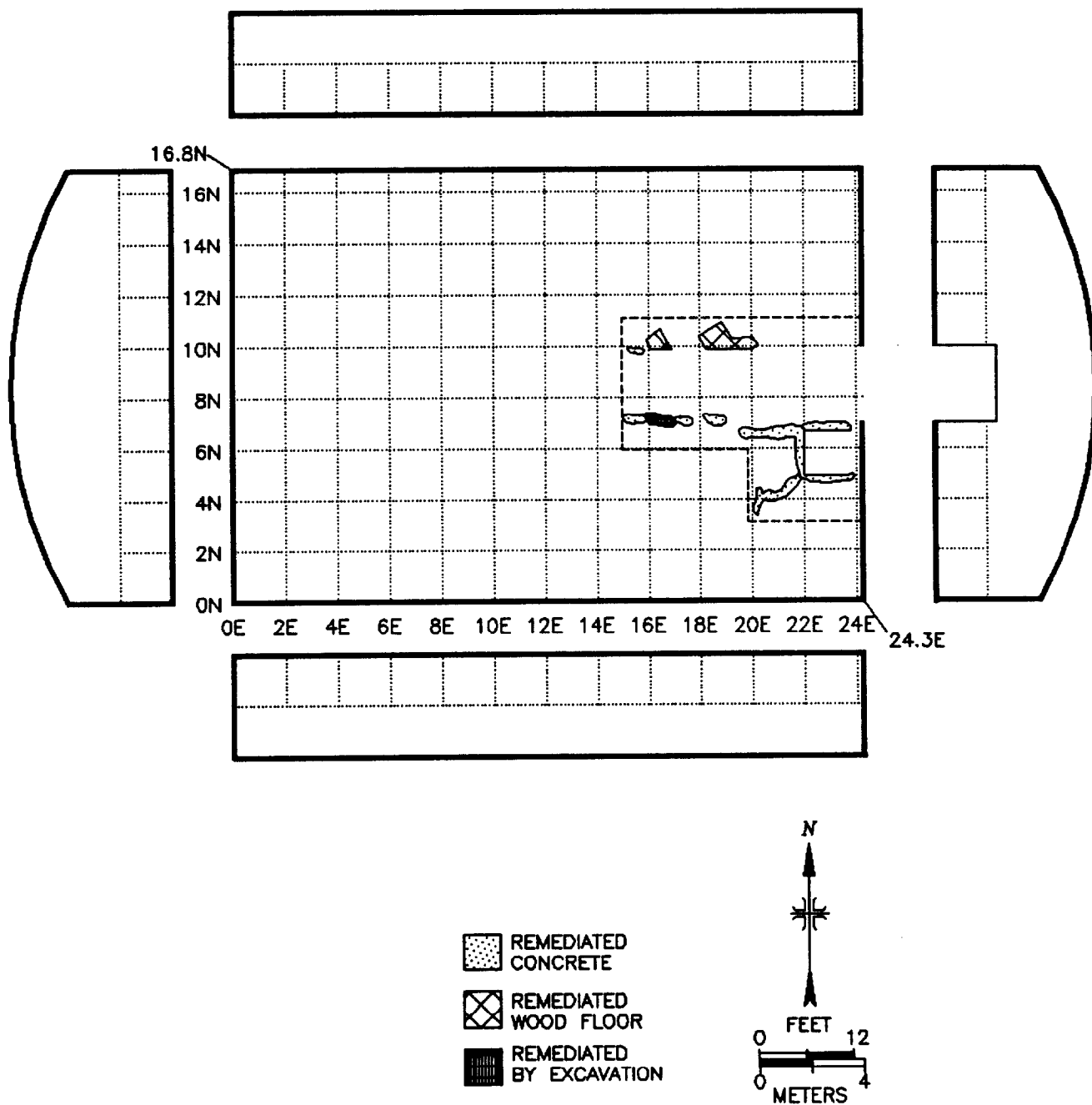


FIGURE 23: Building 5, Machine Shop – Reference Grid and Remediated Area on Floor

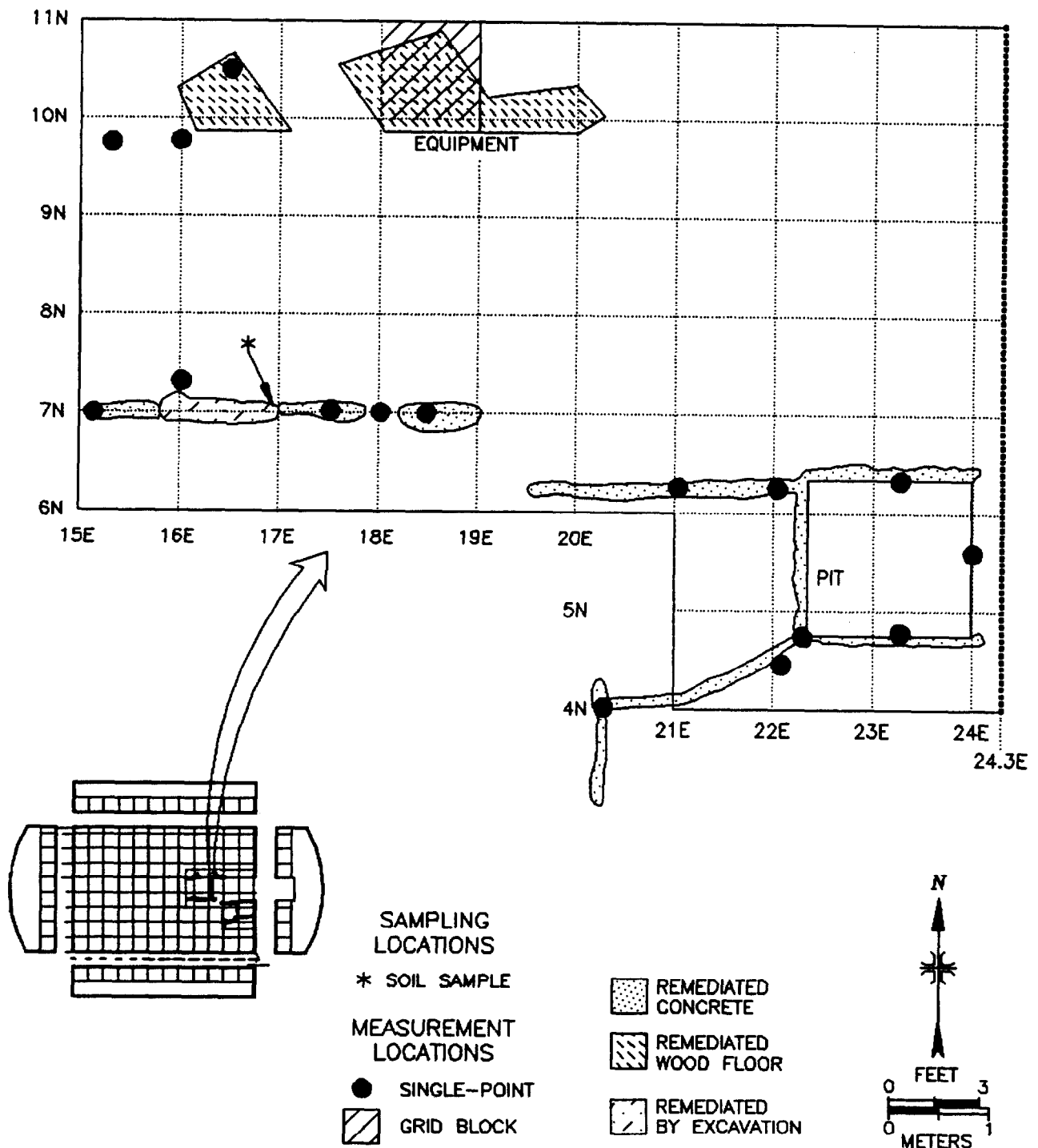


FIGURE 24: Building 5, Machine Shop – Remediated Areas and Measurement and Sampling Locations

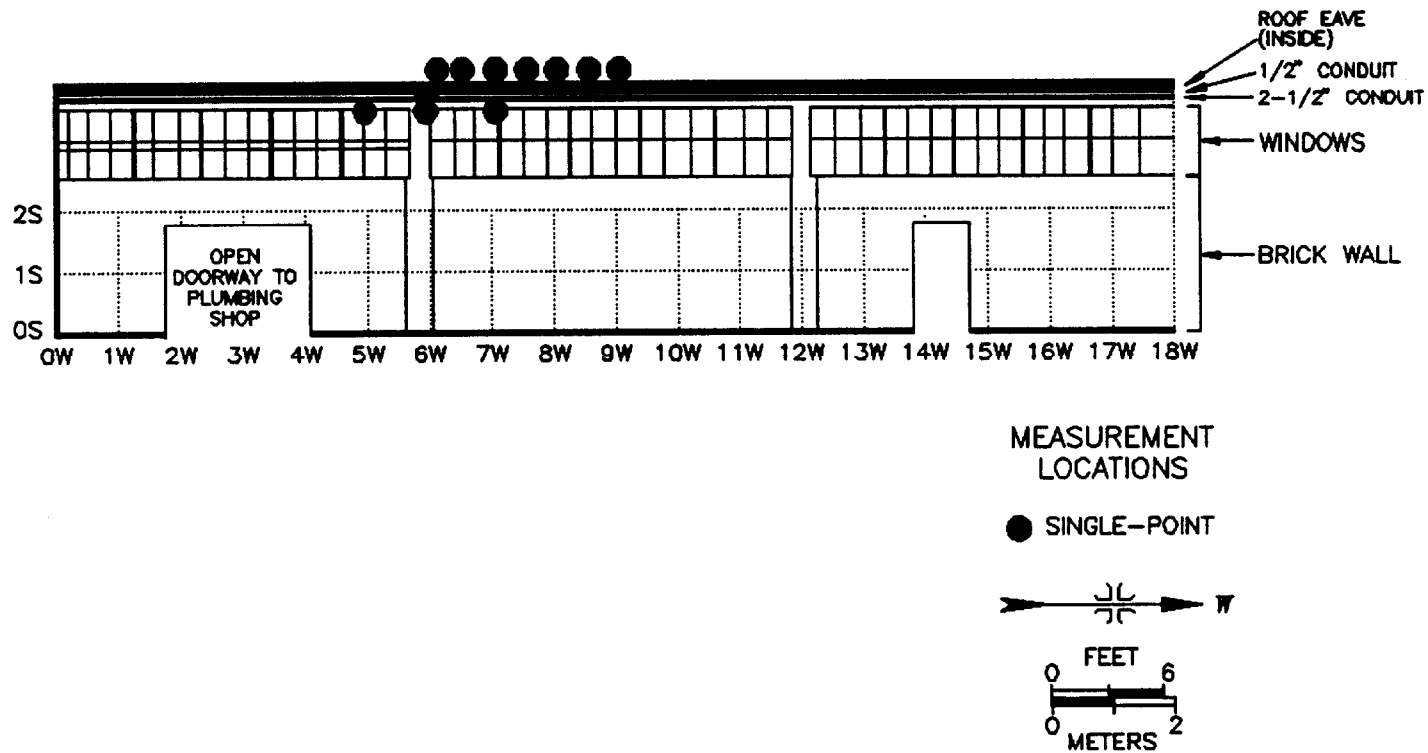


FIGURE 25: Building 5, Machine Shop, South Wall Conduits and Roof Eave – Measurement Locations

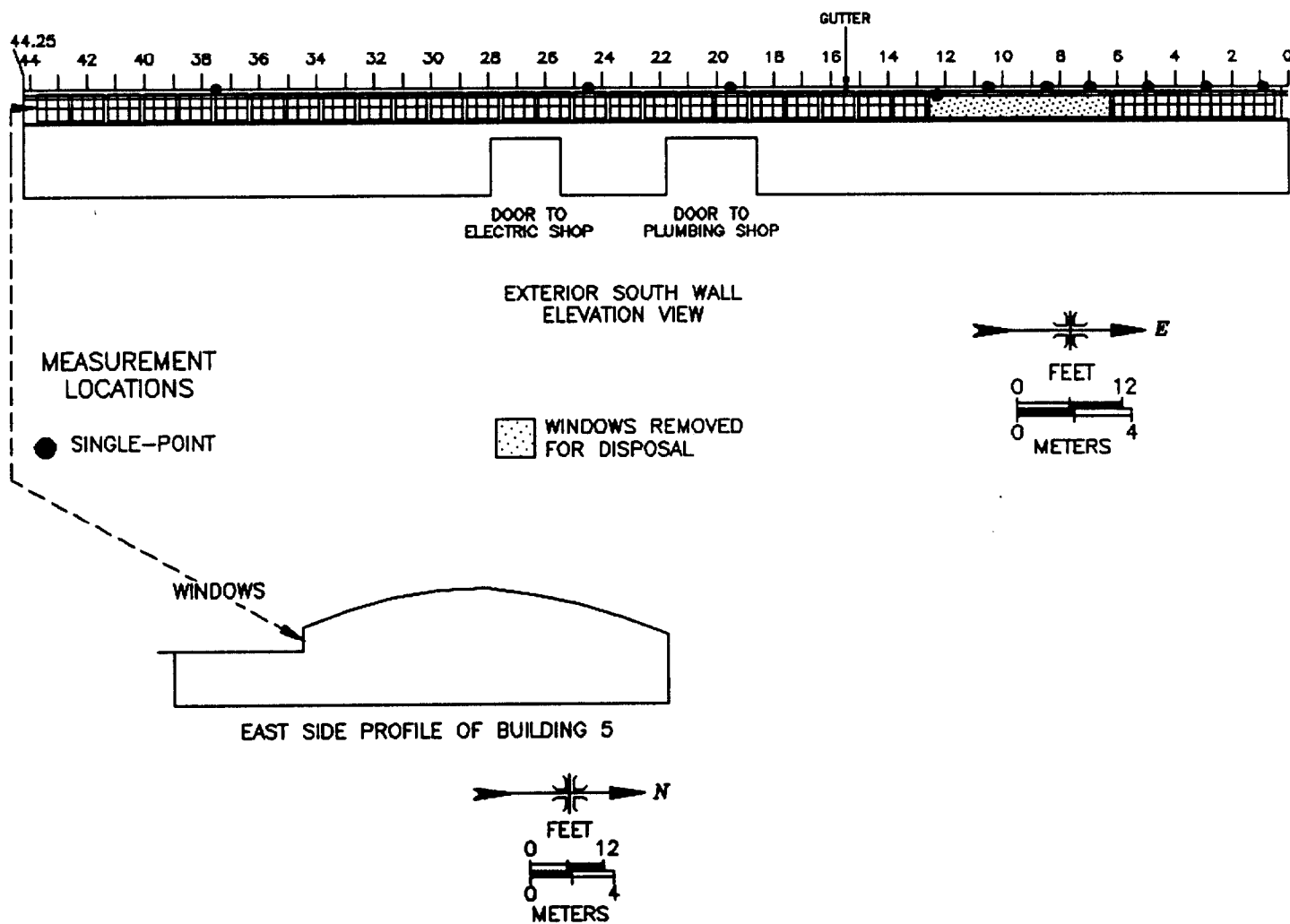


FIGURE 26: Building 5, East Side Profile with Detail of South Side Windows – Measurement Locations

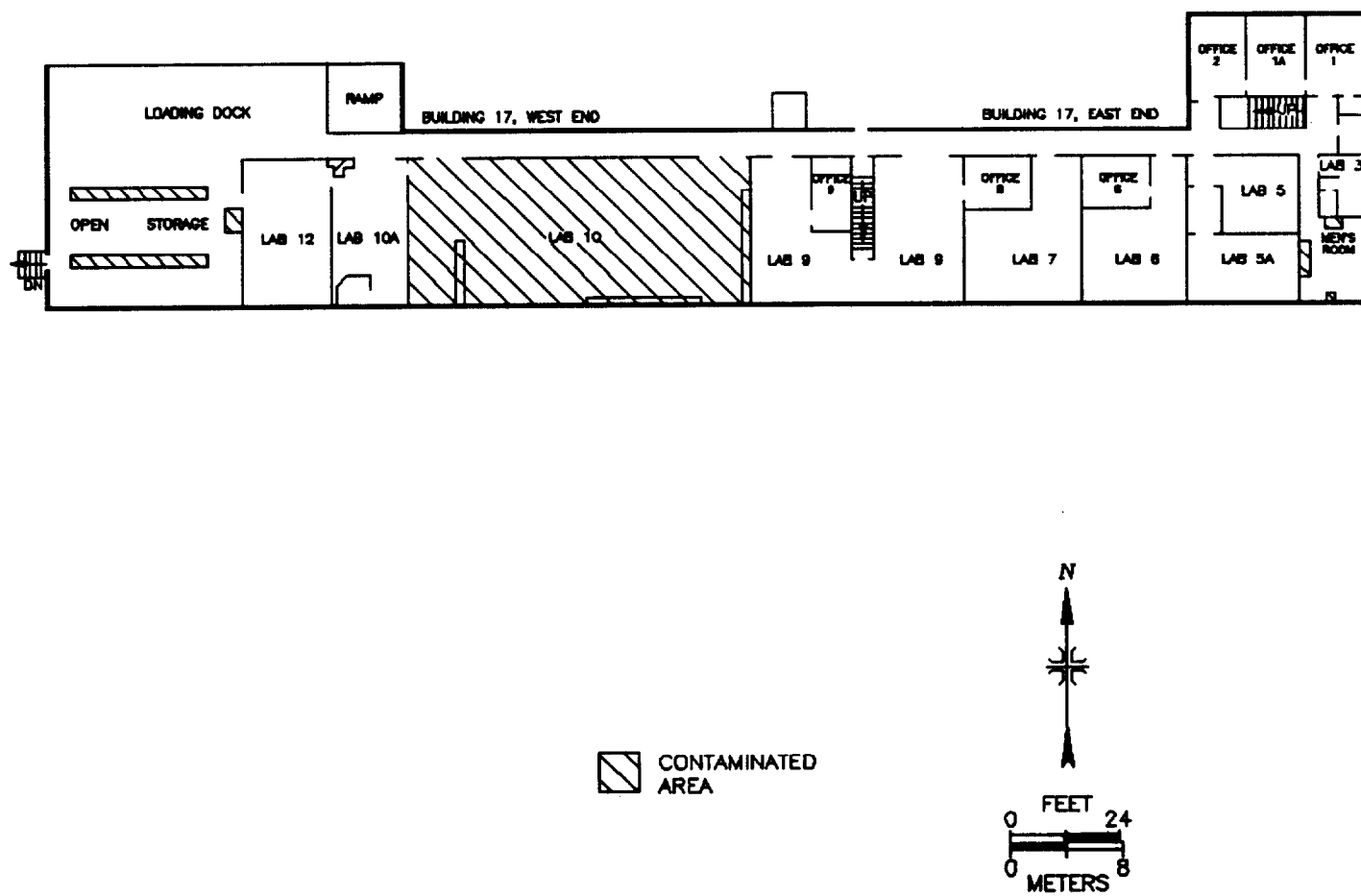
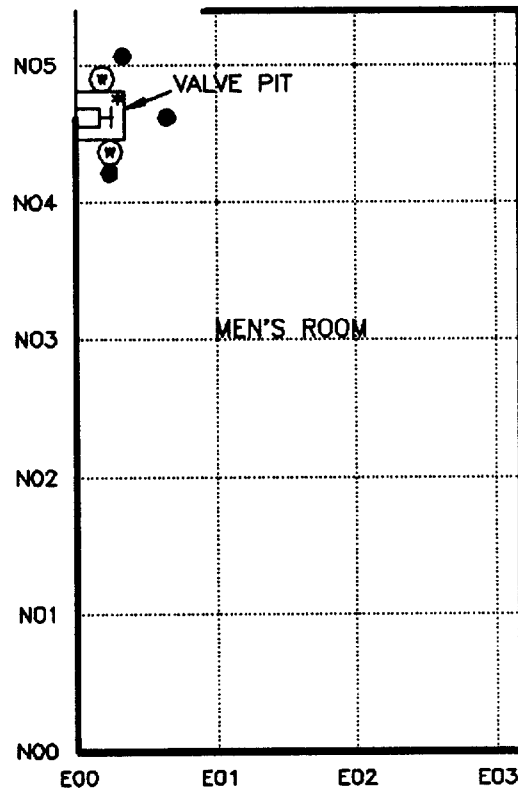


FIGURE 27: Building 17 Plot Plan



- SAMPLING
LOCATION
- * SOIL SAMPLE
- MEASUREMENT
LOCATIONS
- SINGLE-POINT
- ⊙ SINGLE-POINT
TRENCH WALL

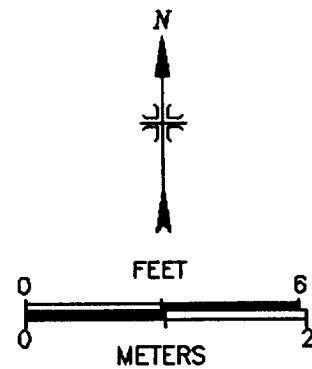


FIGURE 28: Building 17, First Floor Men's Room, Valve Pit –
Measurement and Sampling Locations

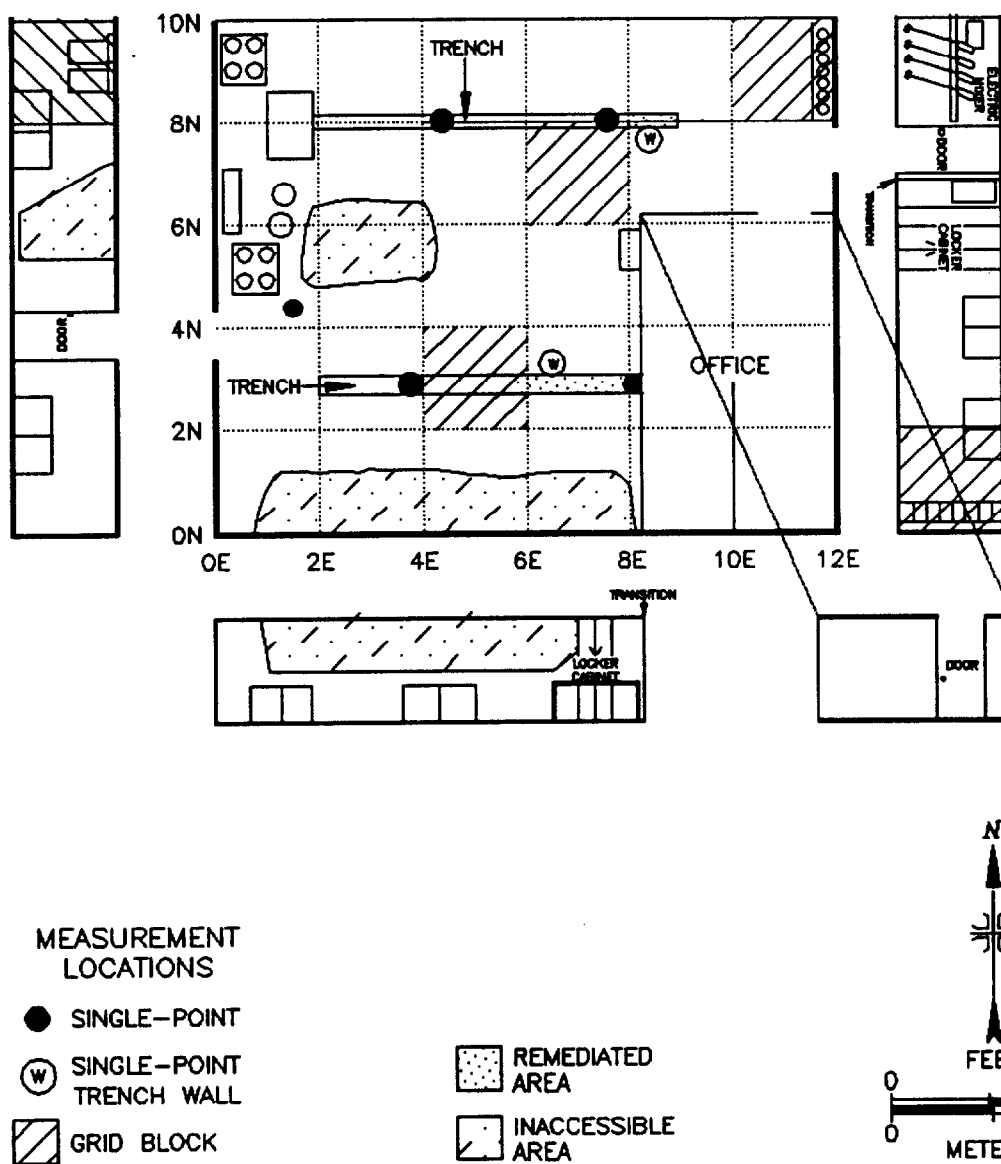


FIGURE 29: Building 17, Open Storage Area, West End Floor and Lower Walls – Measurement Locations

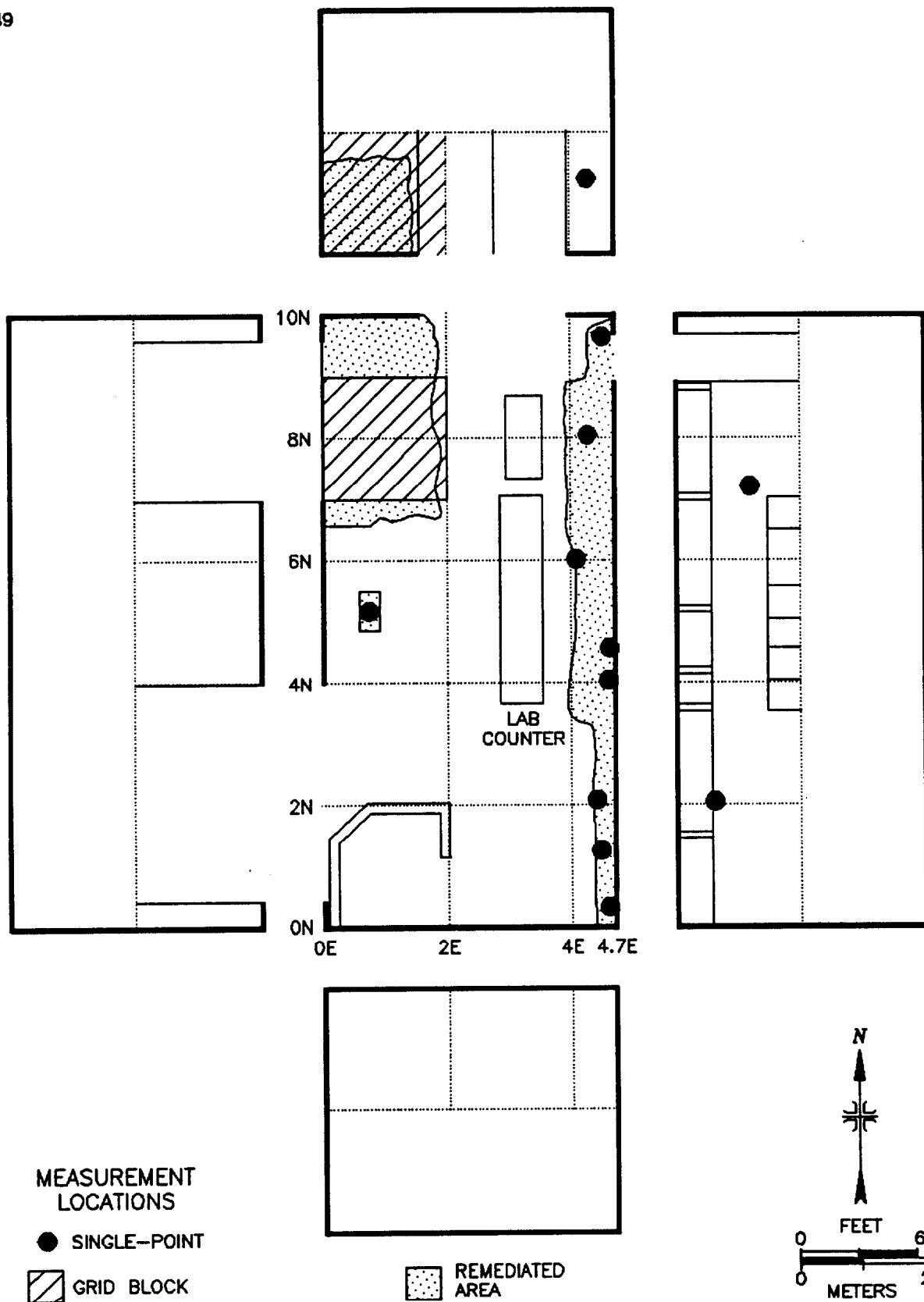


FIGURE 30: Building 17, Lab 10A – Measurement Locations

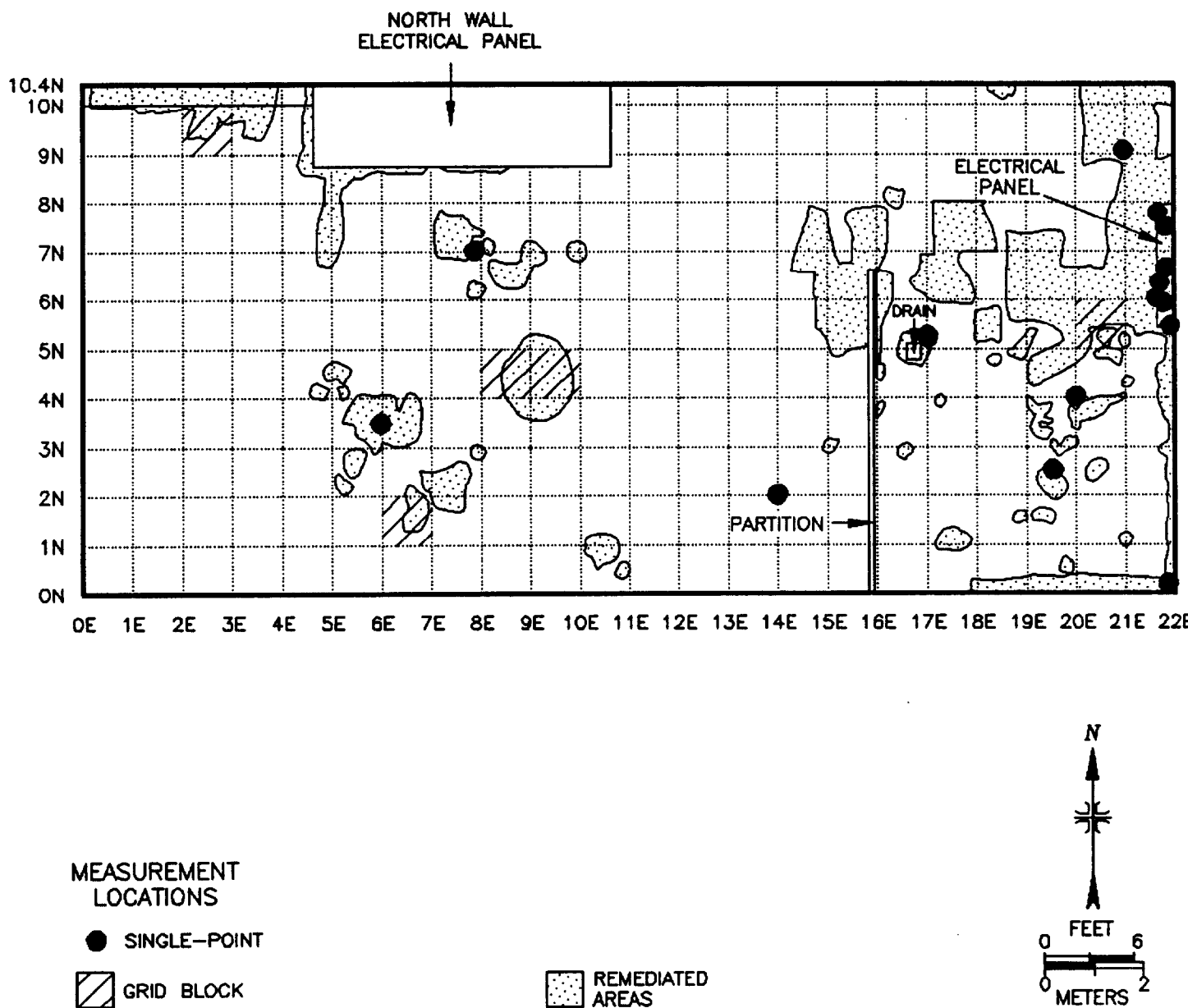


FIGURE 31: Building 17, Lab 10 Floor – Remediated Areas and Measurement Locations

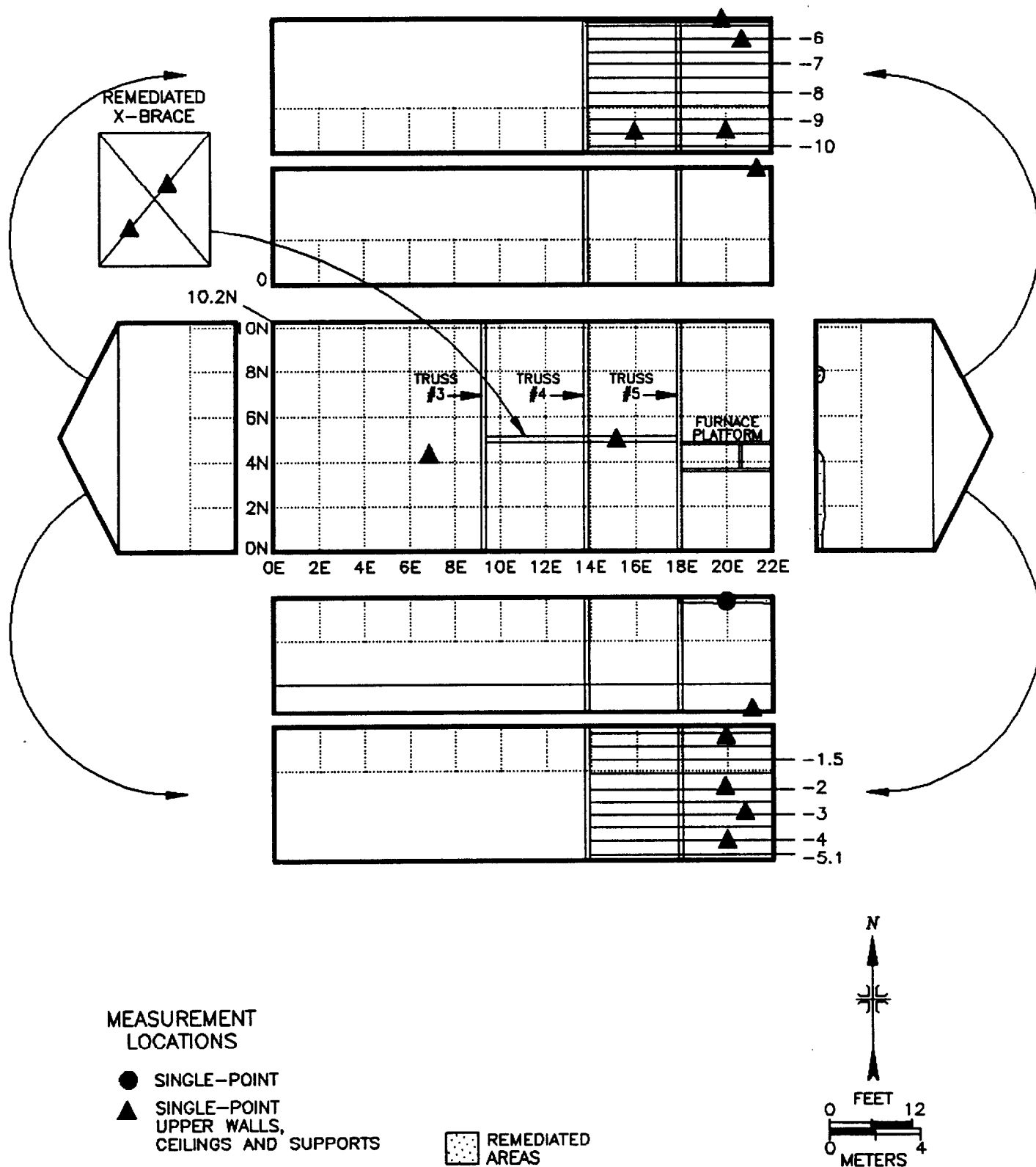
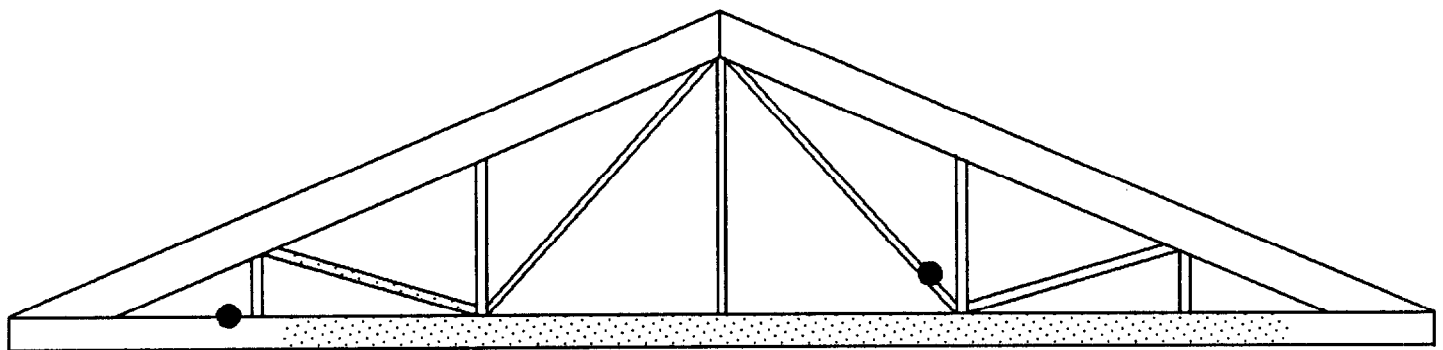


FIGURE 32: Building 17, Lab 10 Walls and Ceiling Support – Remediated Areas and Measurement Locations

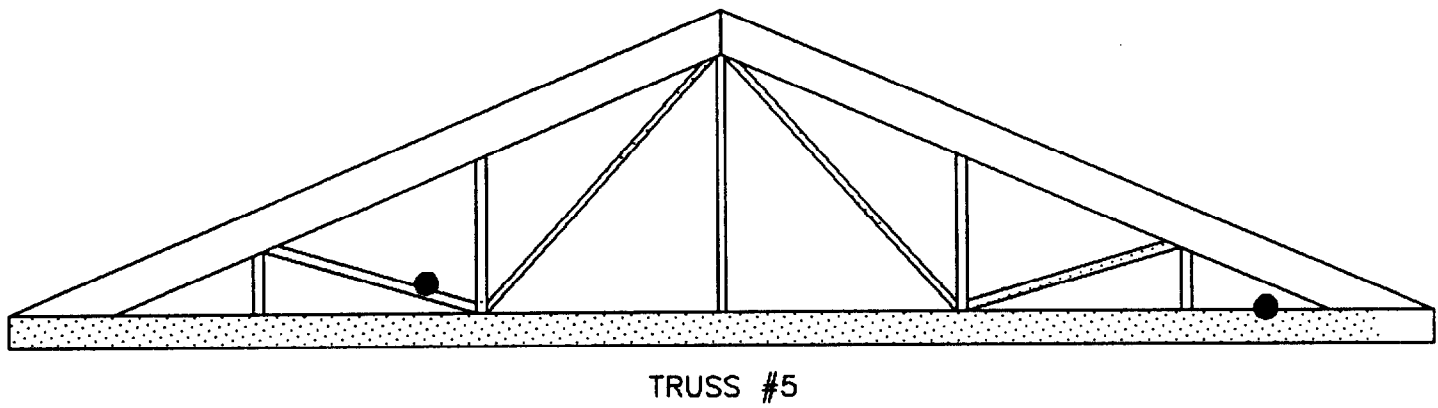
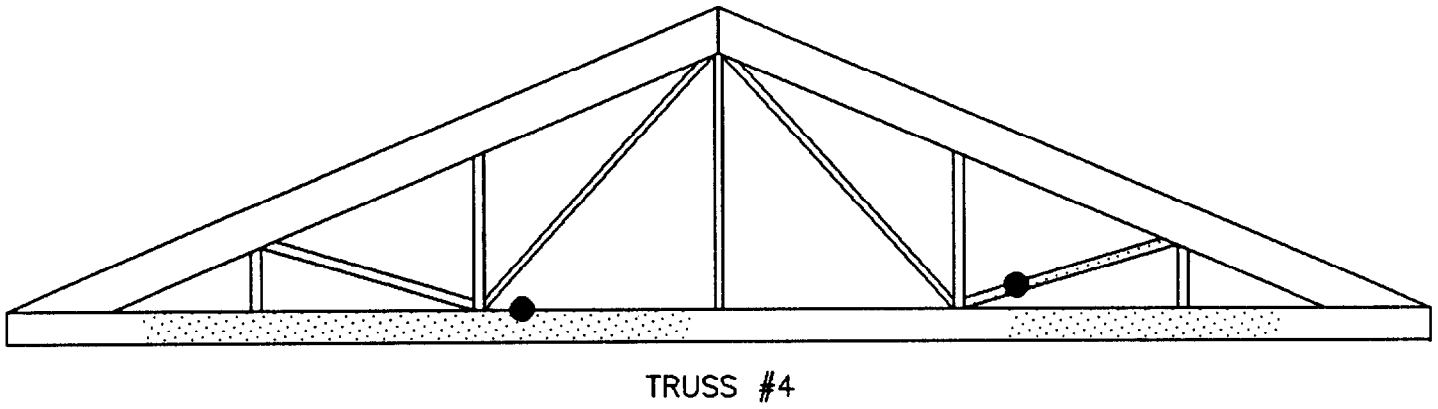


MEASUREMENT
LOCATIONS
● SINGLE-POINT

REMEDIED
AREAS

NOT TO SCALE

FIGURE 33: Building 17, Lab 10, Truss #3, East Side View – Remediated Areas and Measurement Locations

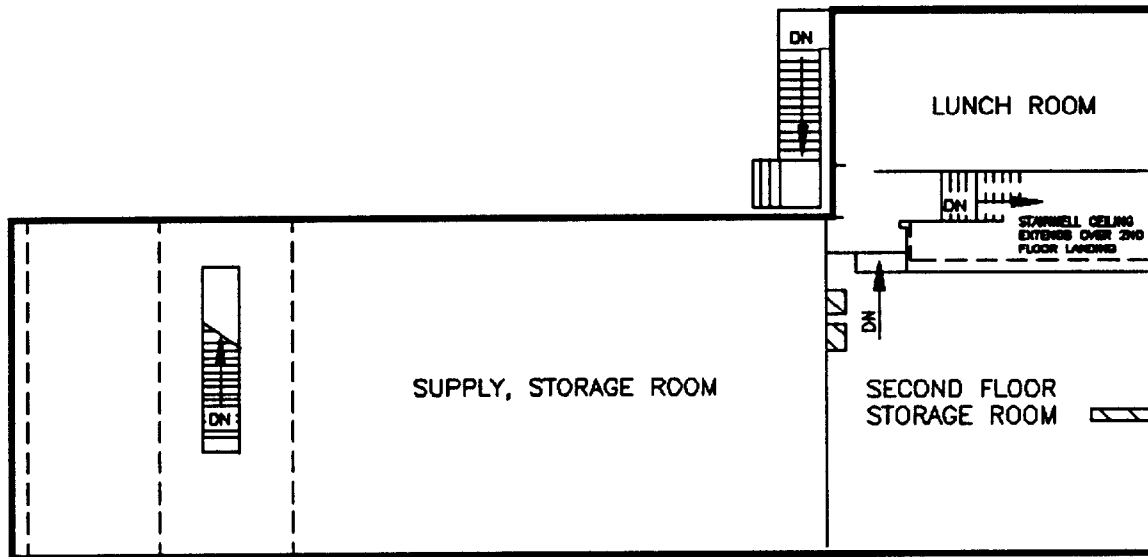


MEASUREMENT
LOCATIONS
● SINGLE-POINT

REMEDIAED
AREAS

NOT TO SCALE

FIGURE 34: Building 17, Lab 10, Trusses #4 and 5,
East Side View – Remediated Areas and
Measurement Locations



 CONTAMINATED AREAS

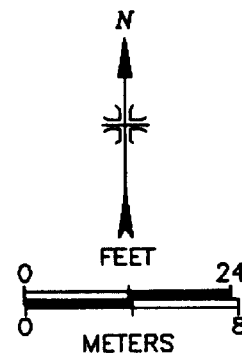


FIGURE 35: Building 17, Plot Plan of Second Floor

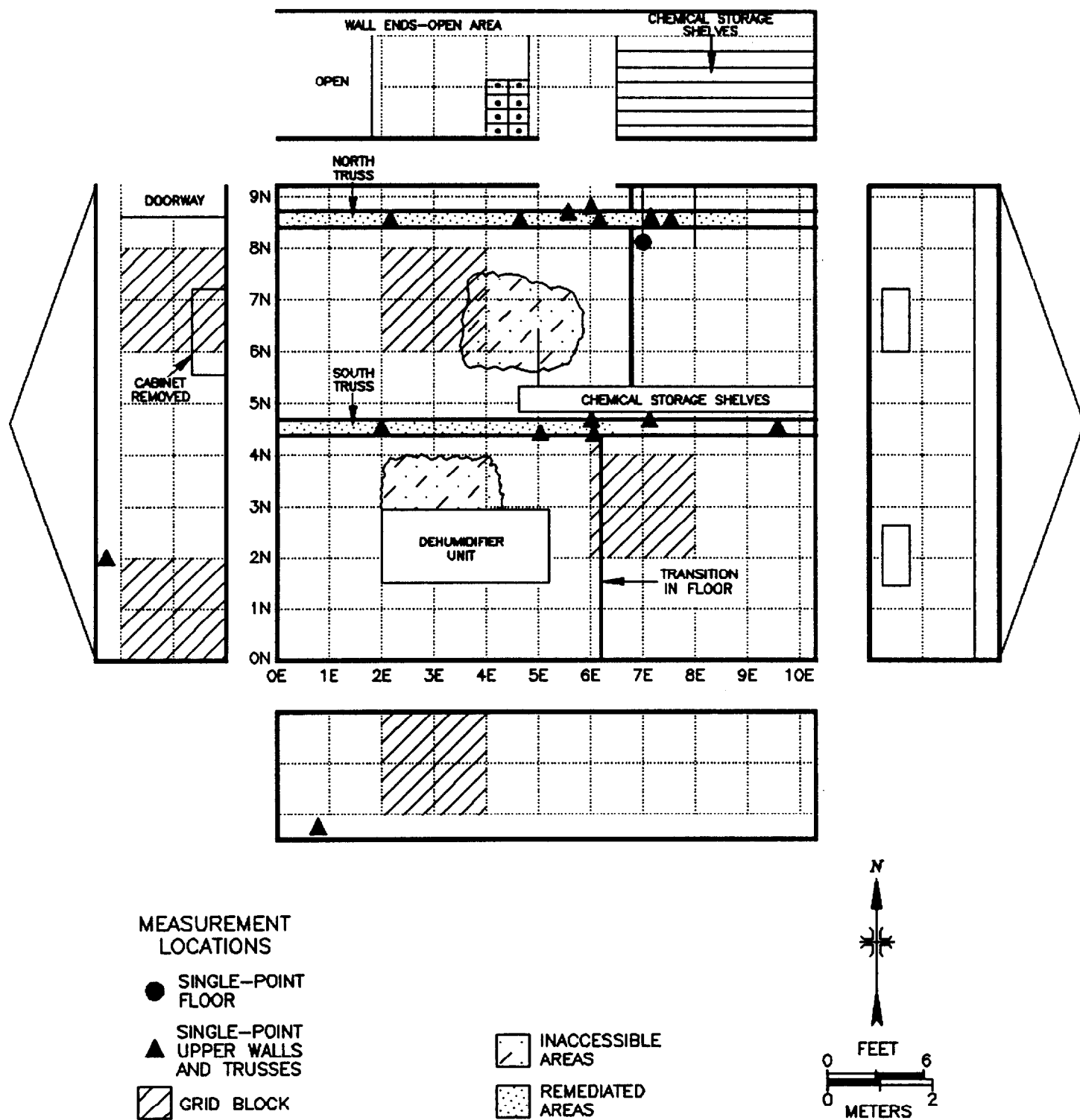


FIGURE 36: Building 17, Second Floor Storage Area – Measurement Locations

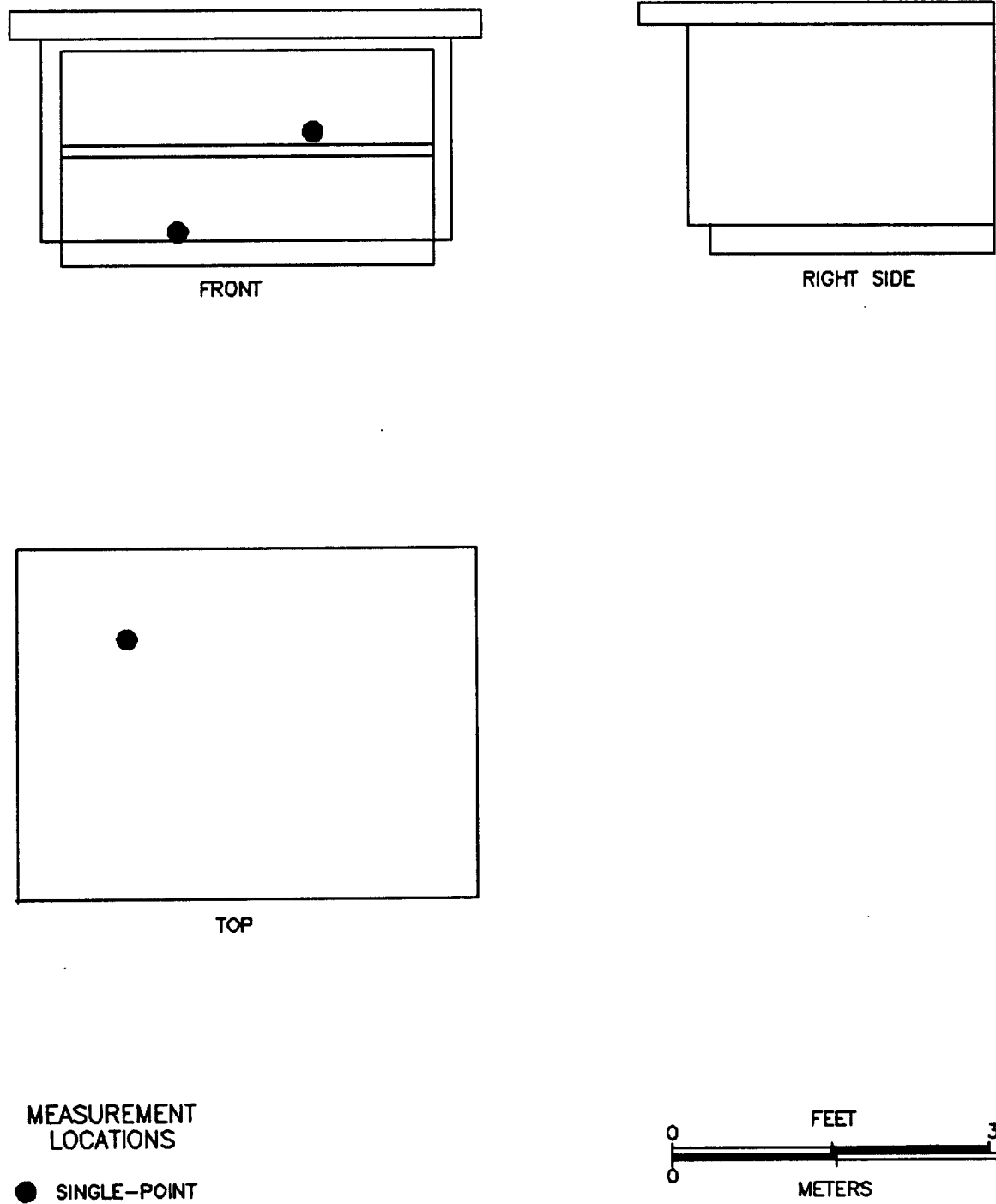


FIGURE 37: Building 17, Second Floor, East Storage Area
Cabinet – Measurement Locations

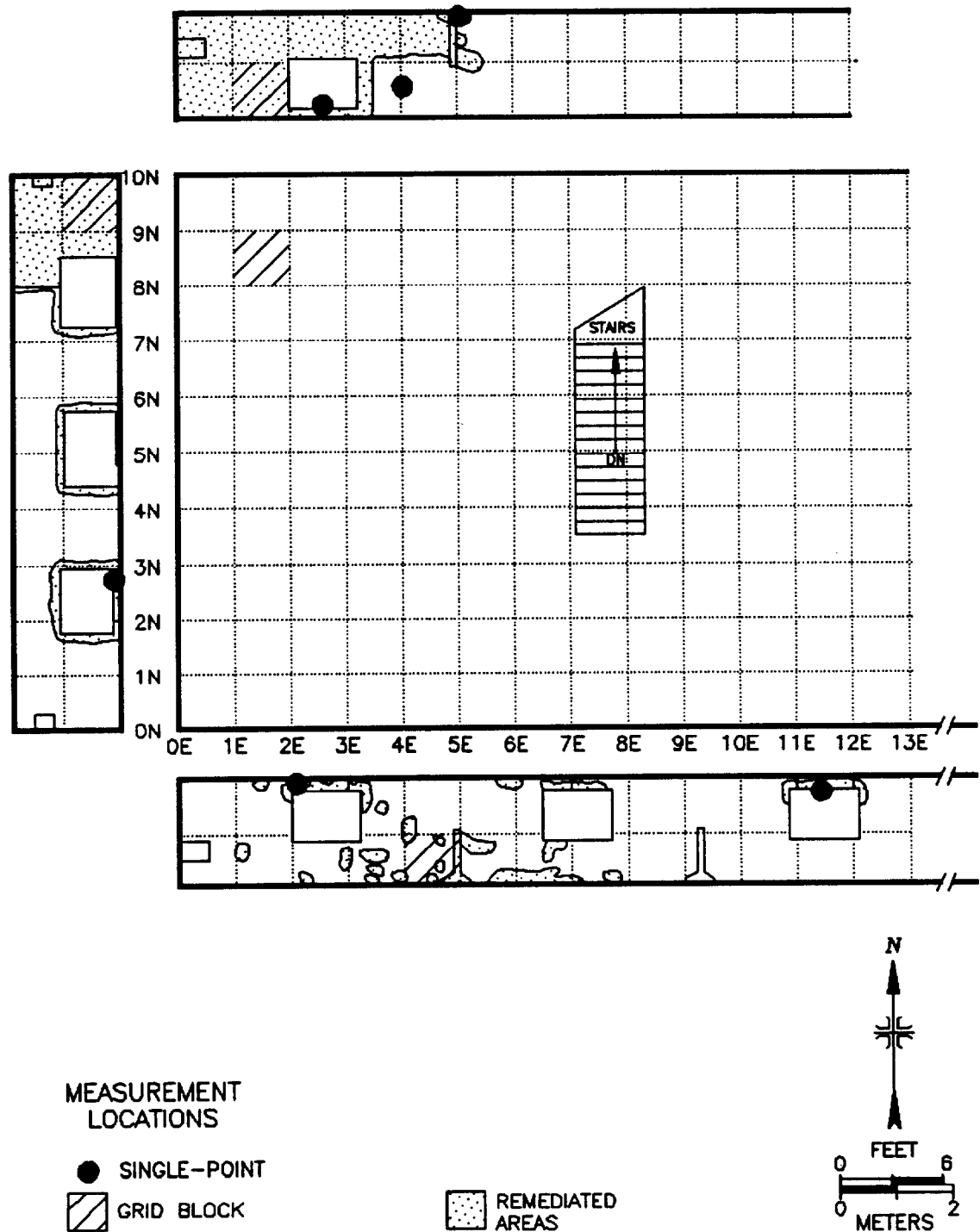


FIGURE 38: Building 17, Second Floor Supply Storage Room, West End – Measurement and Sampling Locations

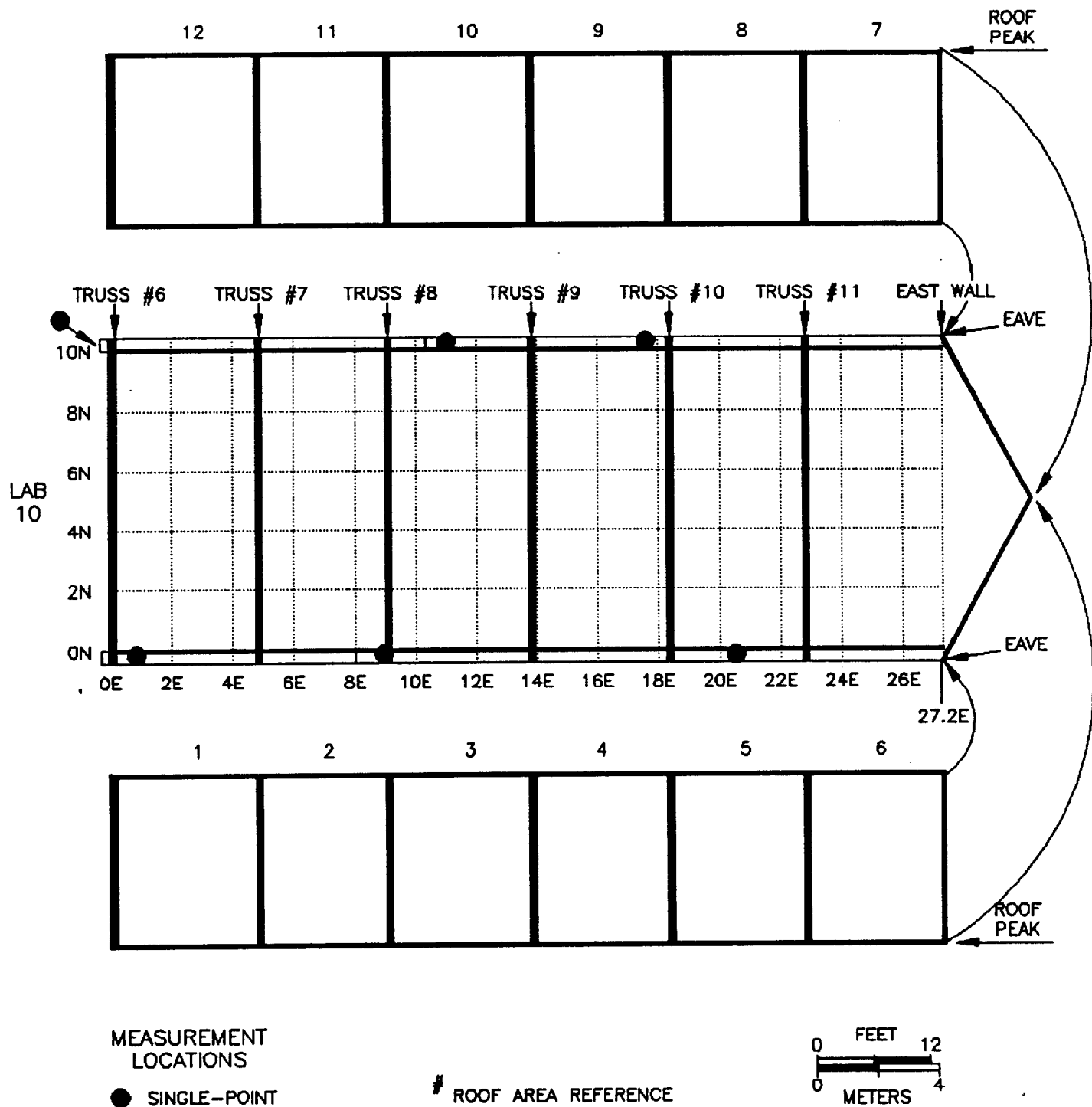


FIGURE 39: Building 17, Attic Eaves, Roof and Trusses – Measurement Locations on Roof Eaves

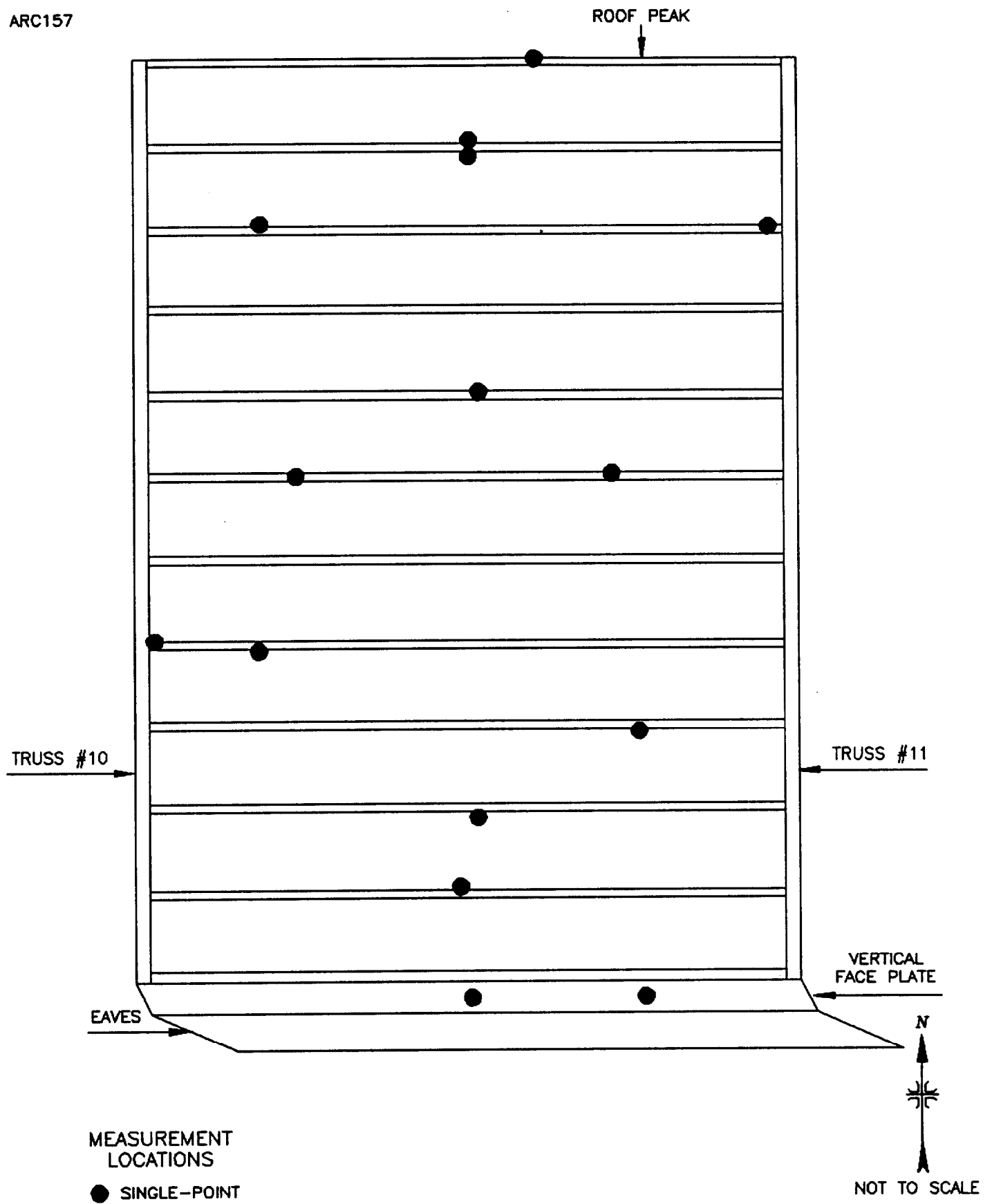


FIGURE 40: Building 17 Attic Ceiling Supports, Area #8 – Measurement Locations

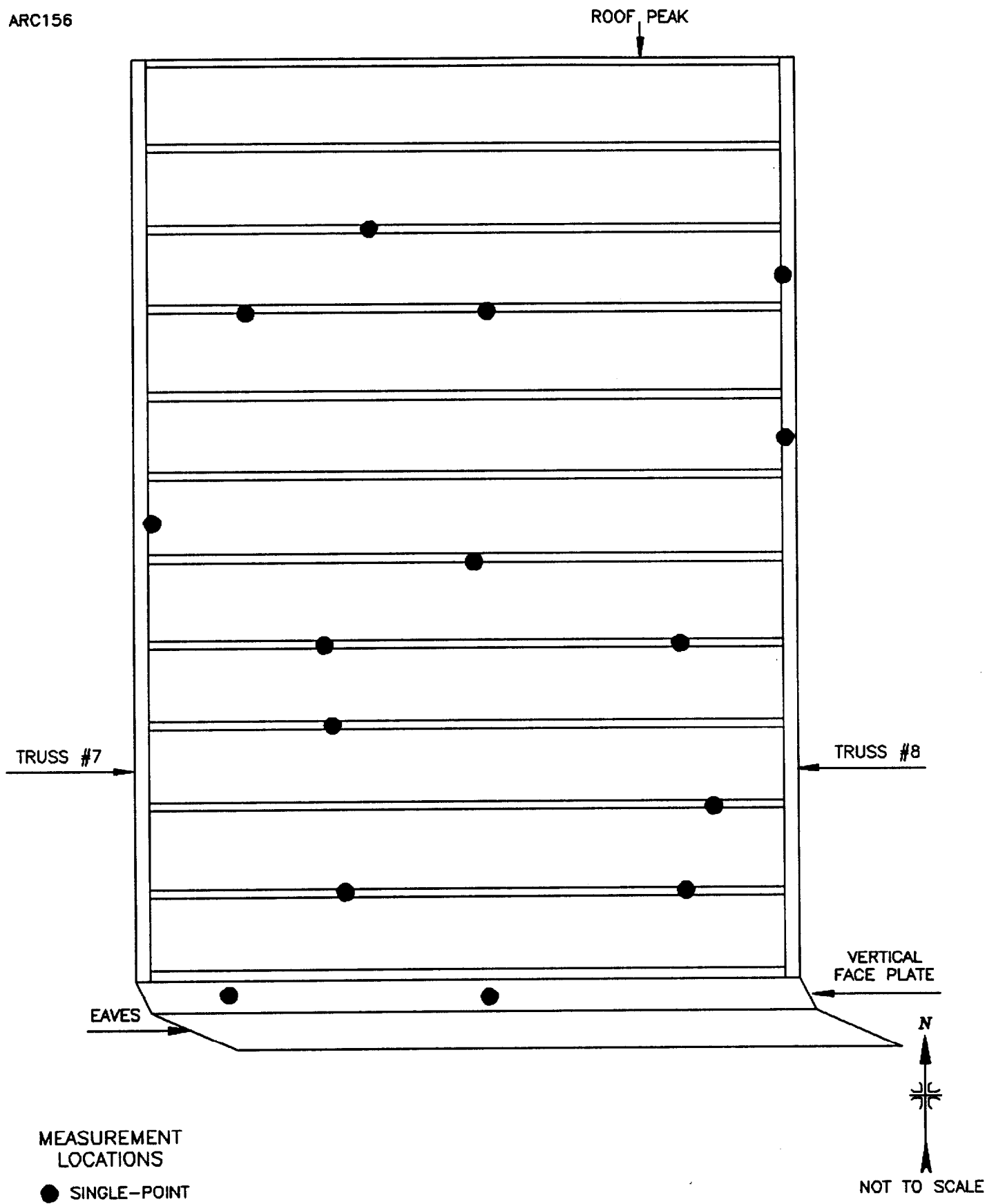
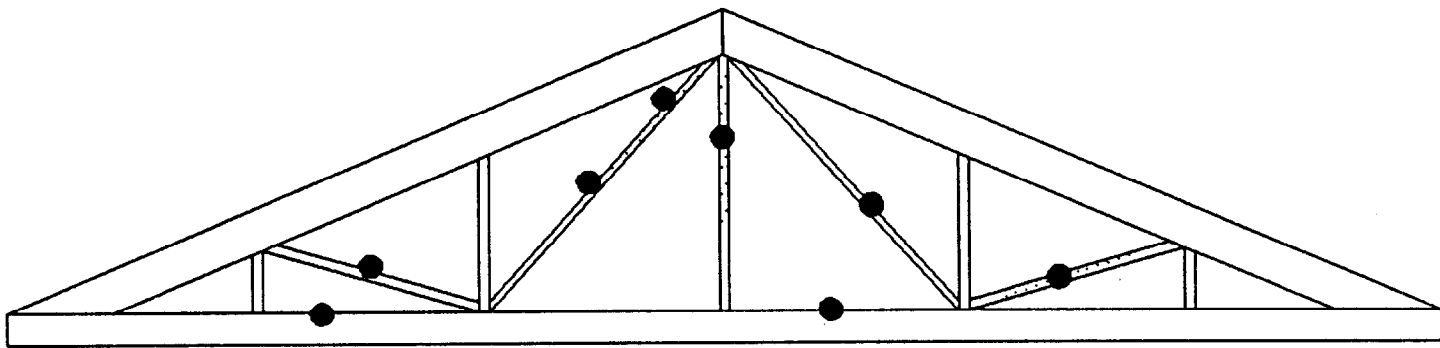


FIGURE 41: Building 17 Attic Ceiling Supports, Area #11 - Measurement Locations



MEASUREMENT
LOCATIONS
● SINGLE-POINT

REMEDIED
AREAS

N
NOT TO SCALE

FIGURE 42: Building 17, Attic Truss #9, West Side View -
Measurement Locations

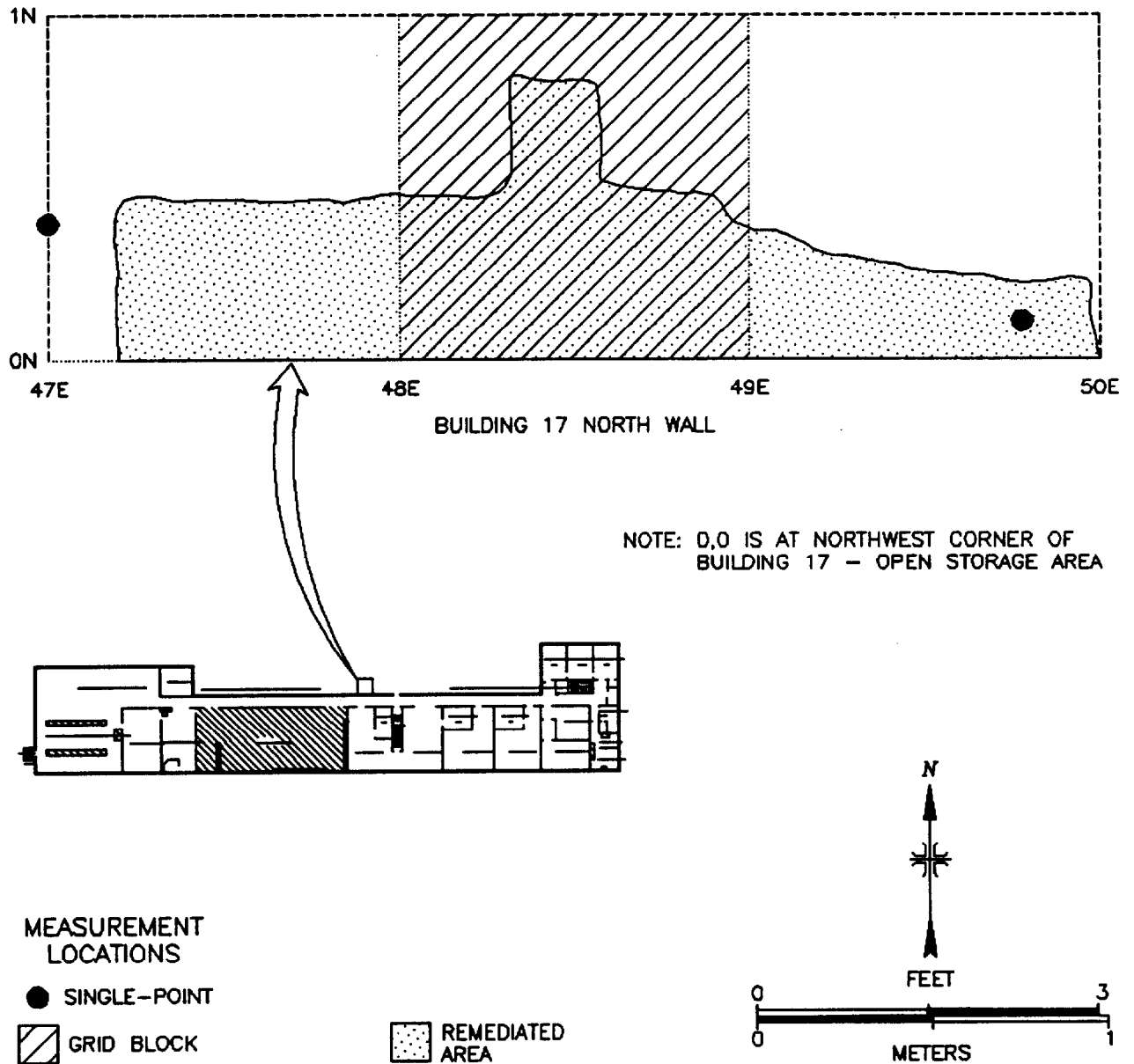
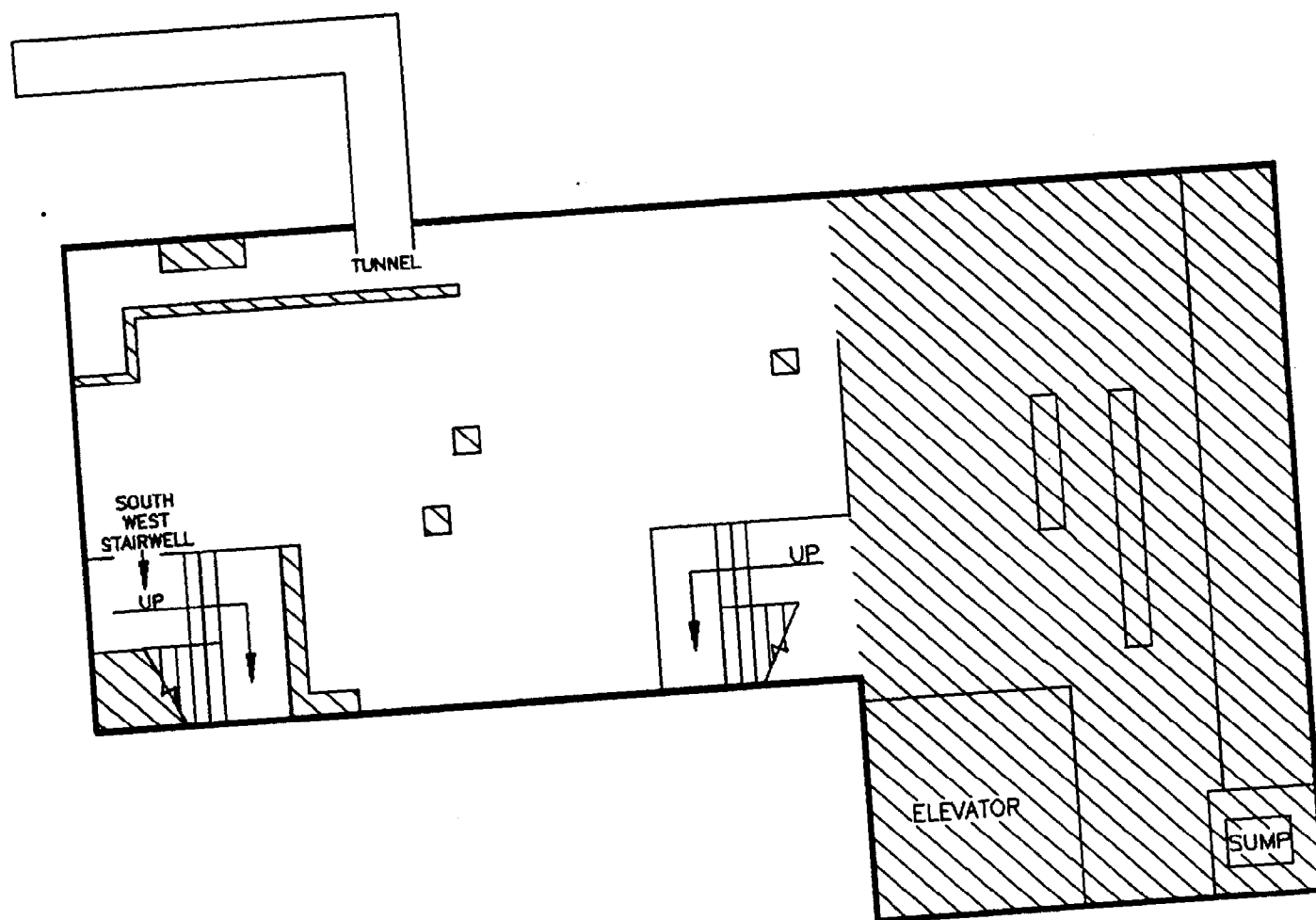


FIGURE 43: Building 17, Sidewalk Outside Lab 10 – Remediated Areas and Measurement Locations




 CONTAMINATED AREA

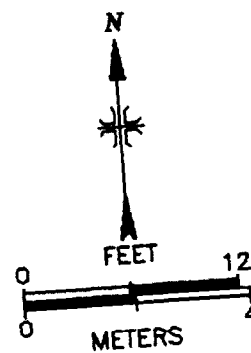


FIGURE 44: Plot Plan of Building 23, Basement

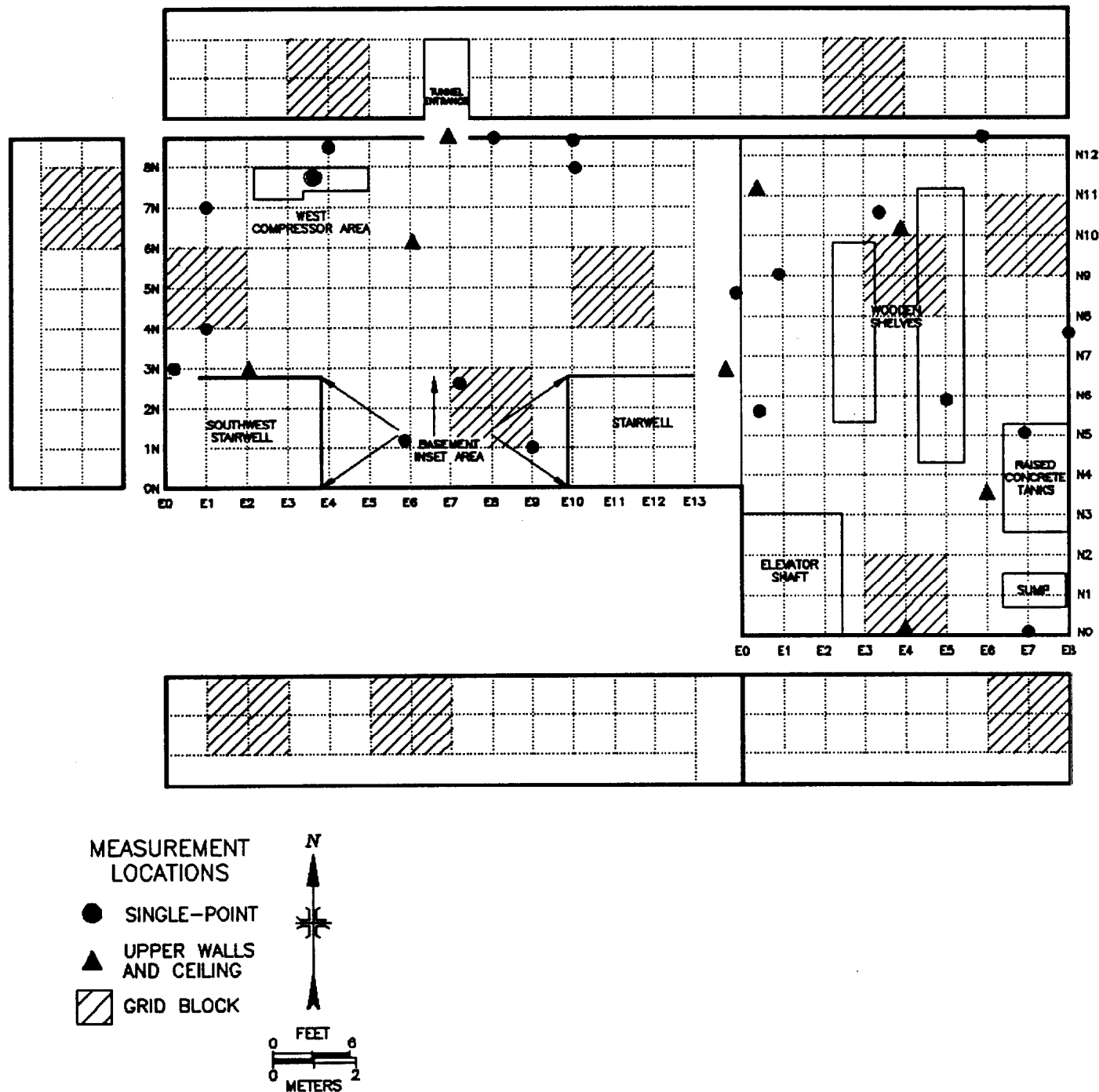


FIGURE 45: Building 23 Basement – Measurement Locations

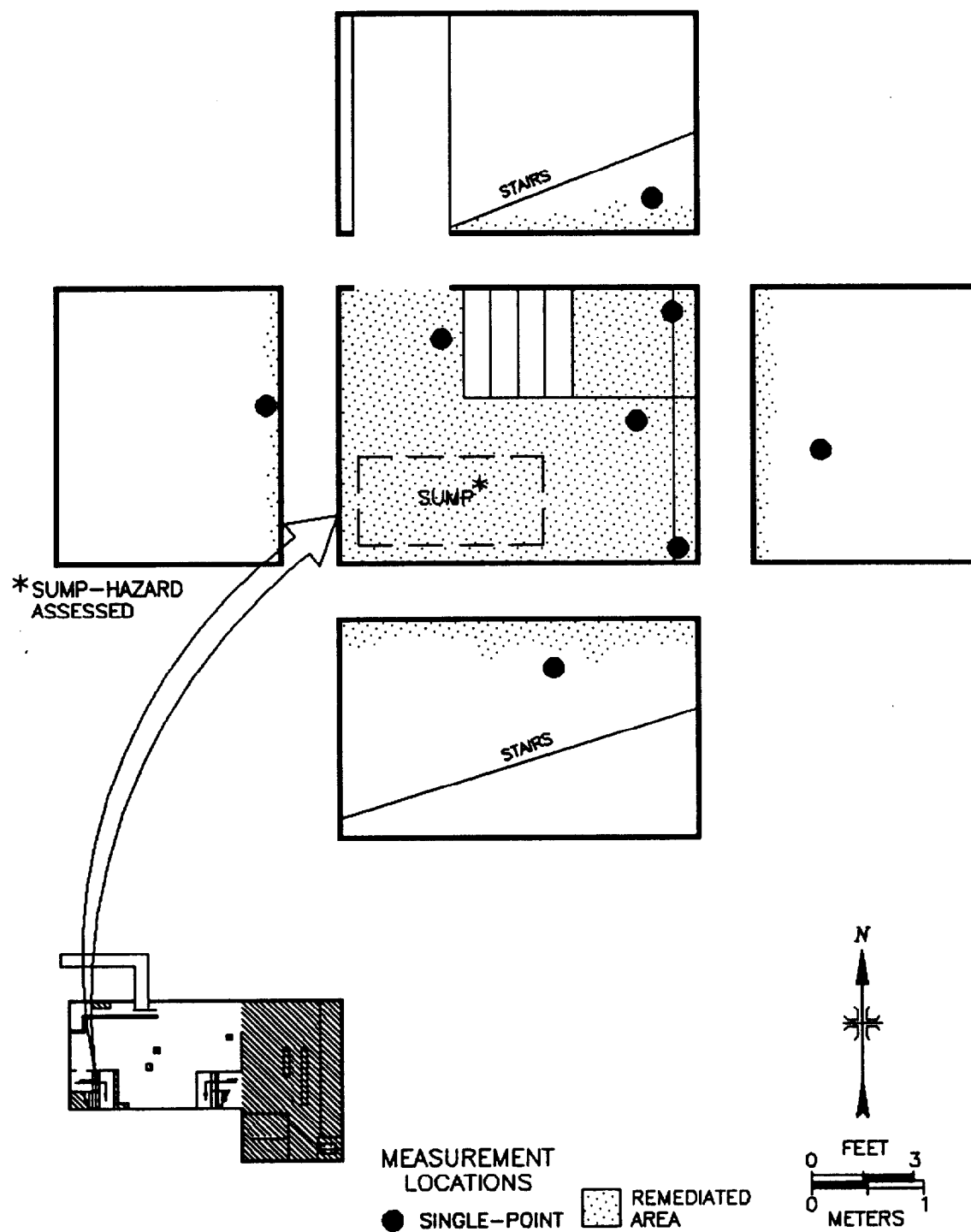


FIGURE 46: Building 23, Basement, Southwest Stairwell – Remediated Areas and Measurement Locations

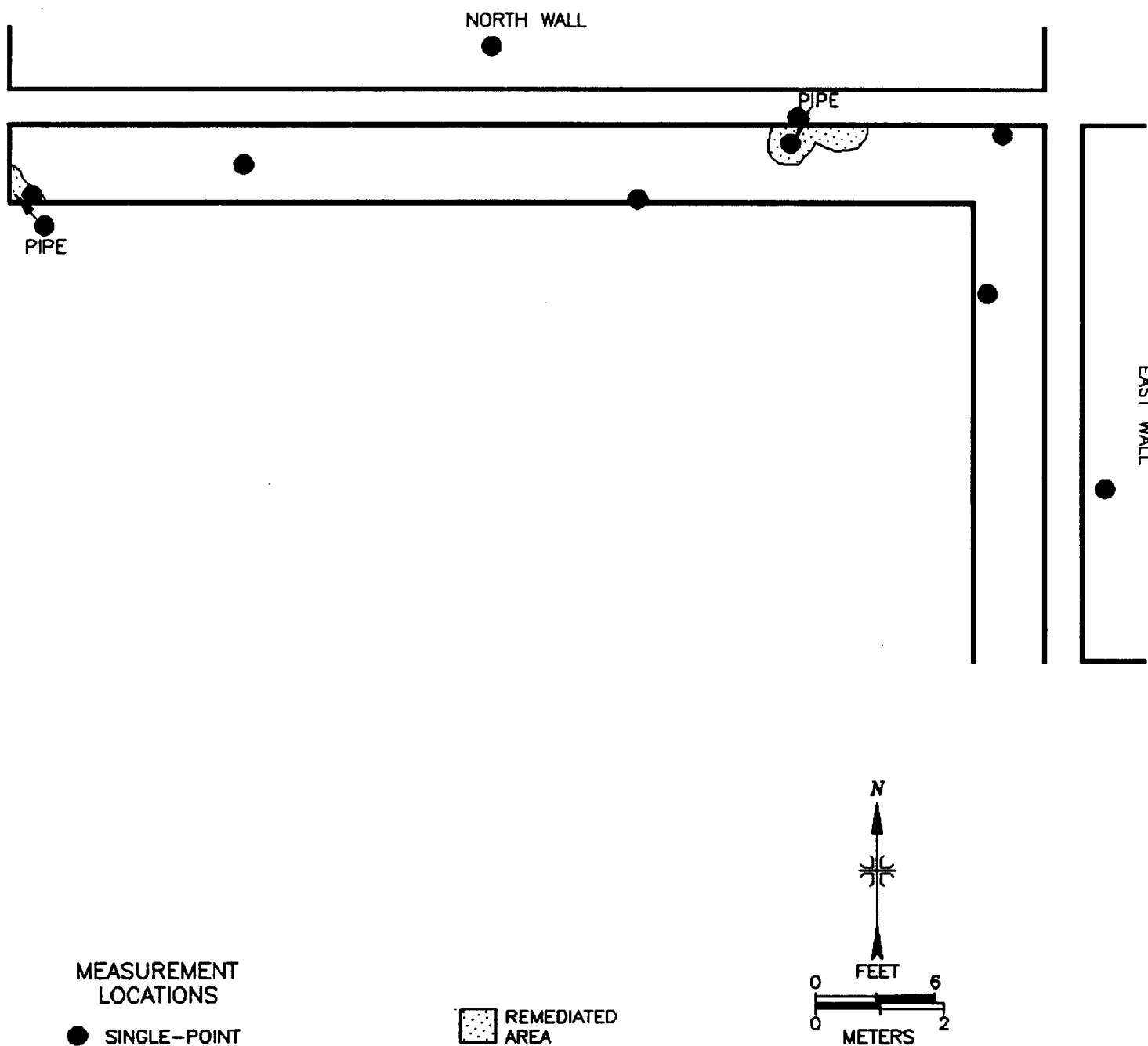


FIGURE 47: Building 23, Basement Tunnel – Measurement Locations

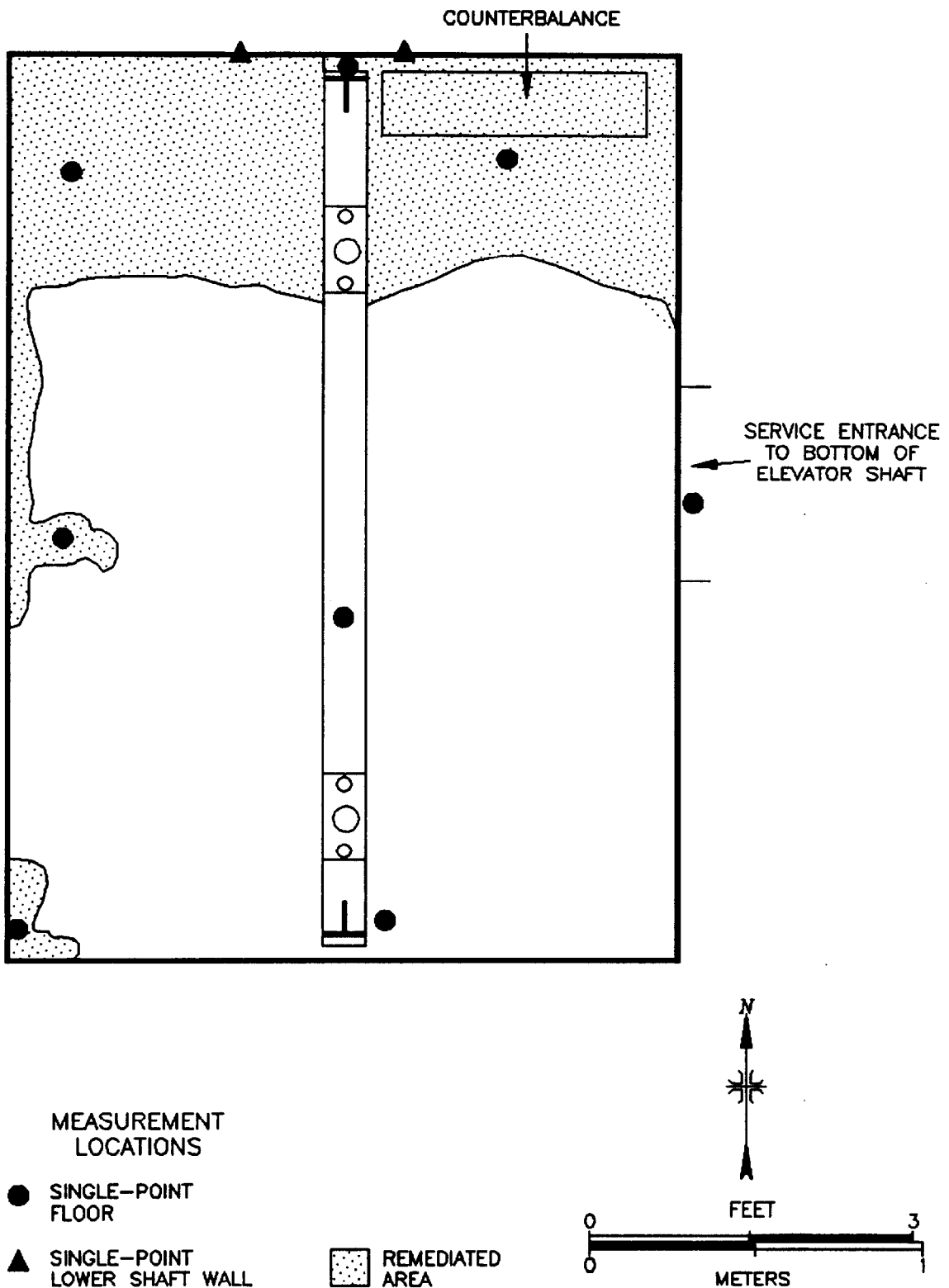


FIGURE 48: Building 23, Basement, Southeast Corner Elevator Shaft-Floor and Lower Wall – Remediated Areas and Measurement Locations

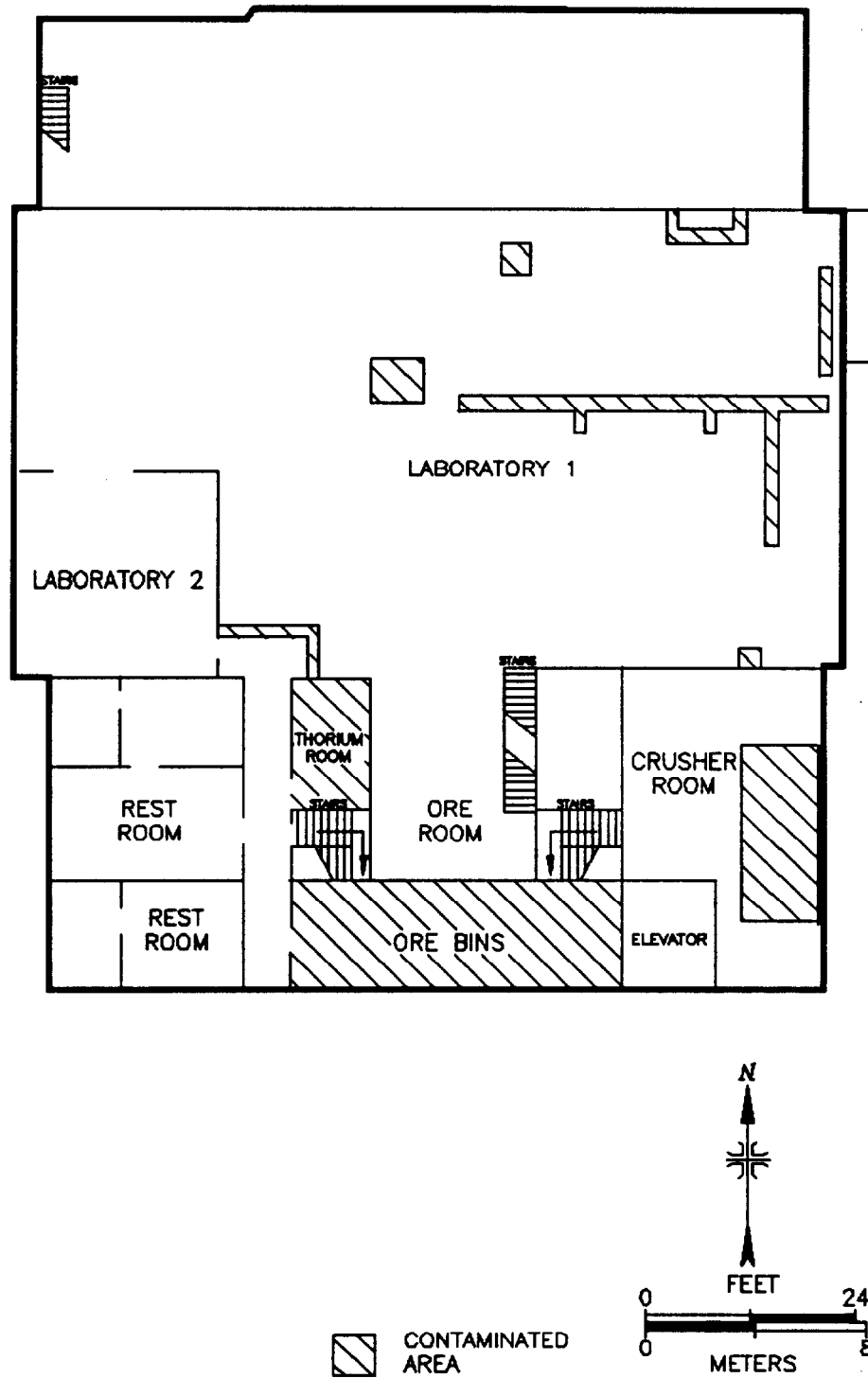


FIGURE 49: Plot Plan of Building 23, First Floor

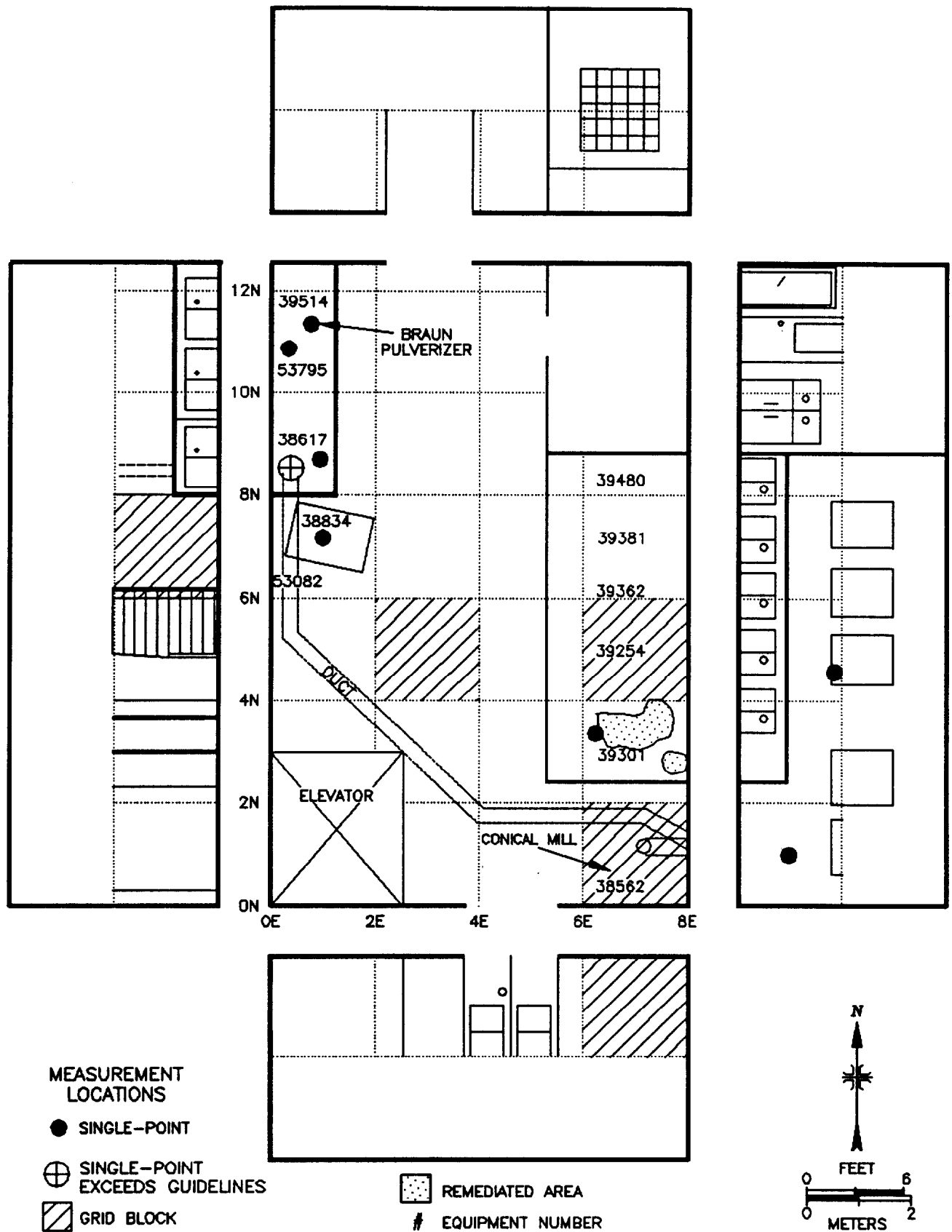


FIGURE 50: Building 23, Crusher Room, First Floor – Remediated Areas and Measurement Locations

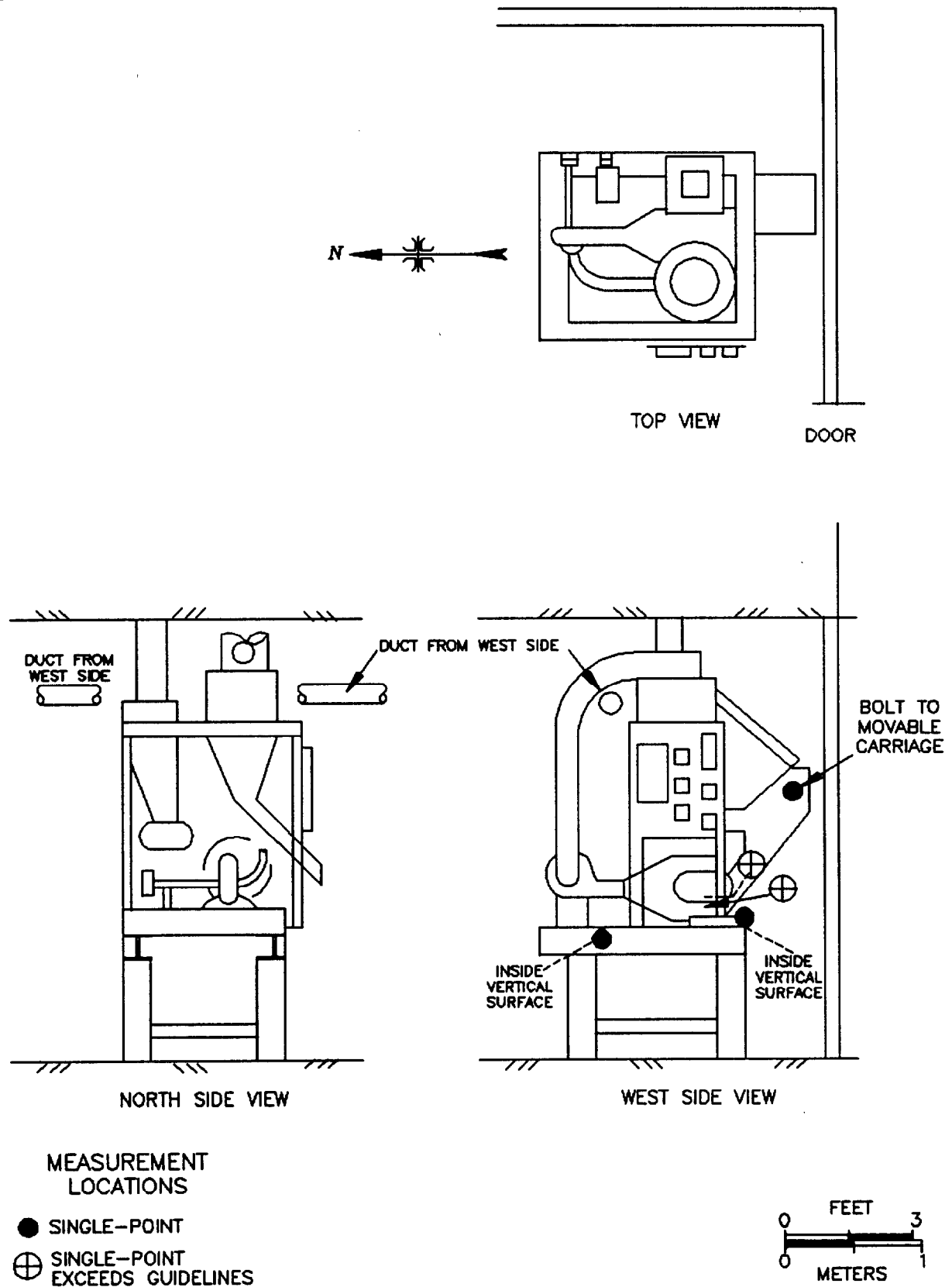


FIGURE 51: Building 23, First Floor, Crusher Room, Conical Mill #38562 - Measurement Locations

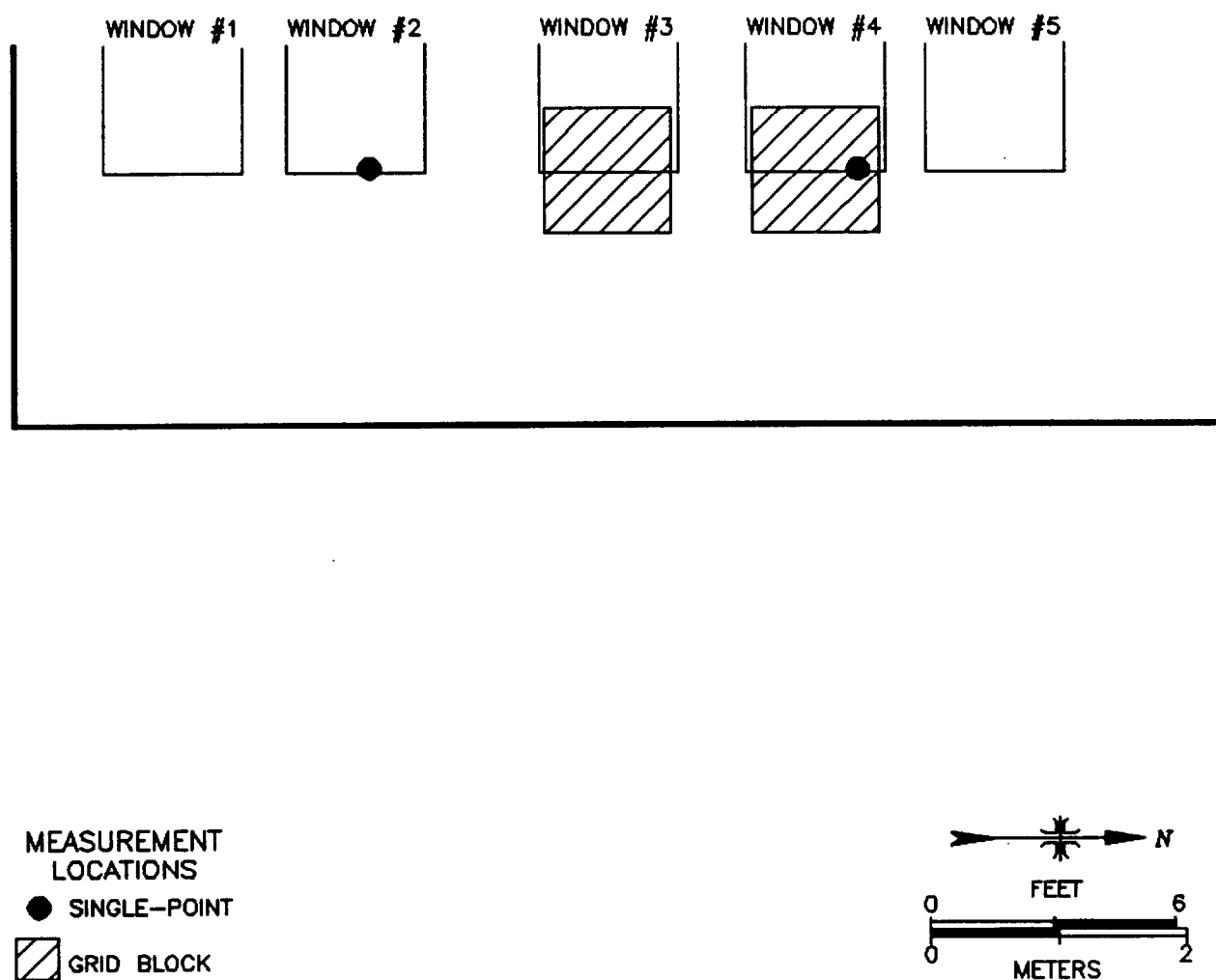


FIGURE 52: Building 23, Exterior East Wall, Outside Crusher Room First Floor – Measurement Locations

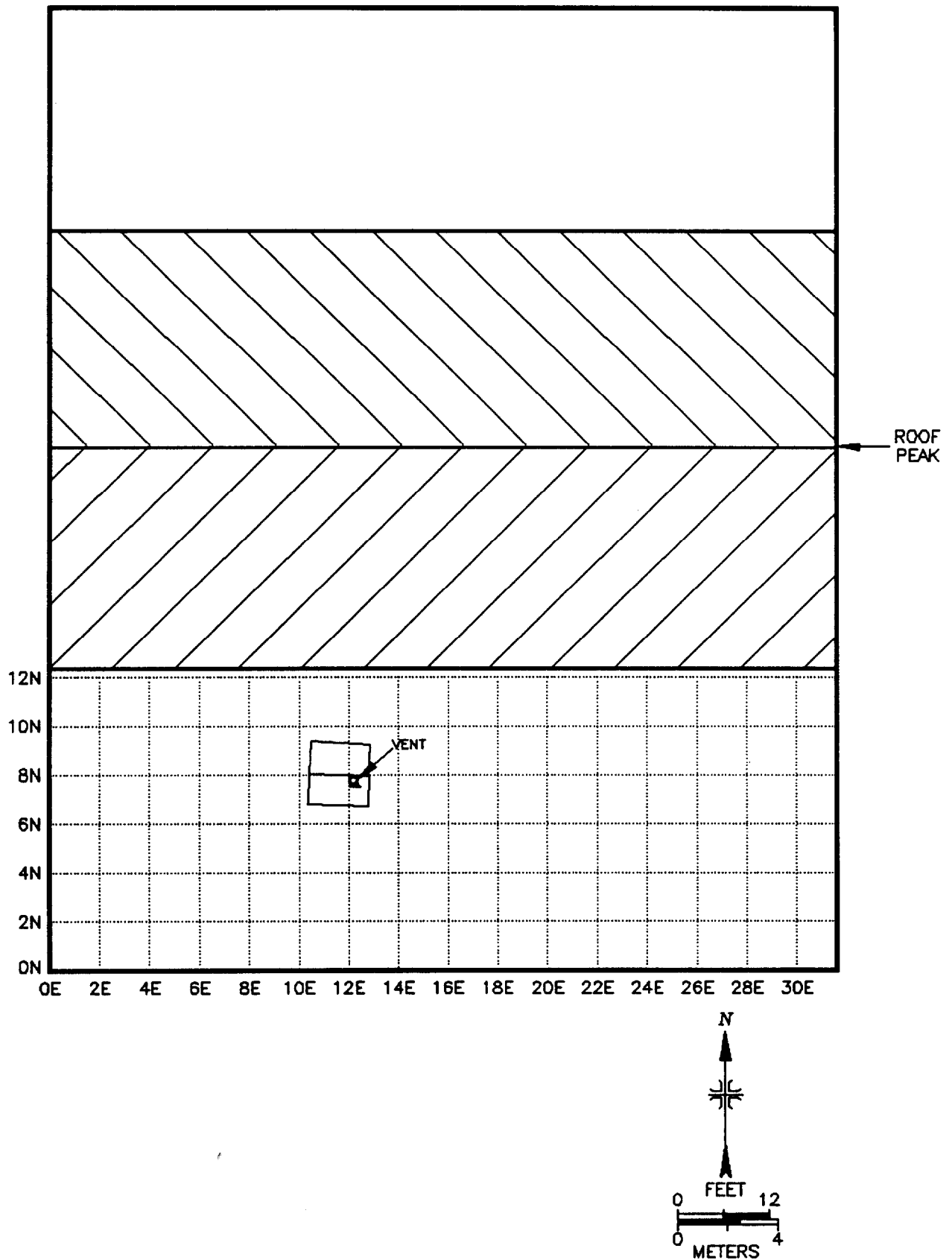
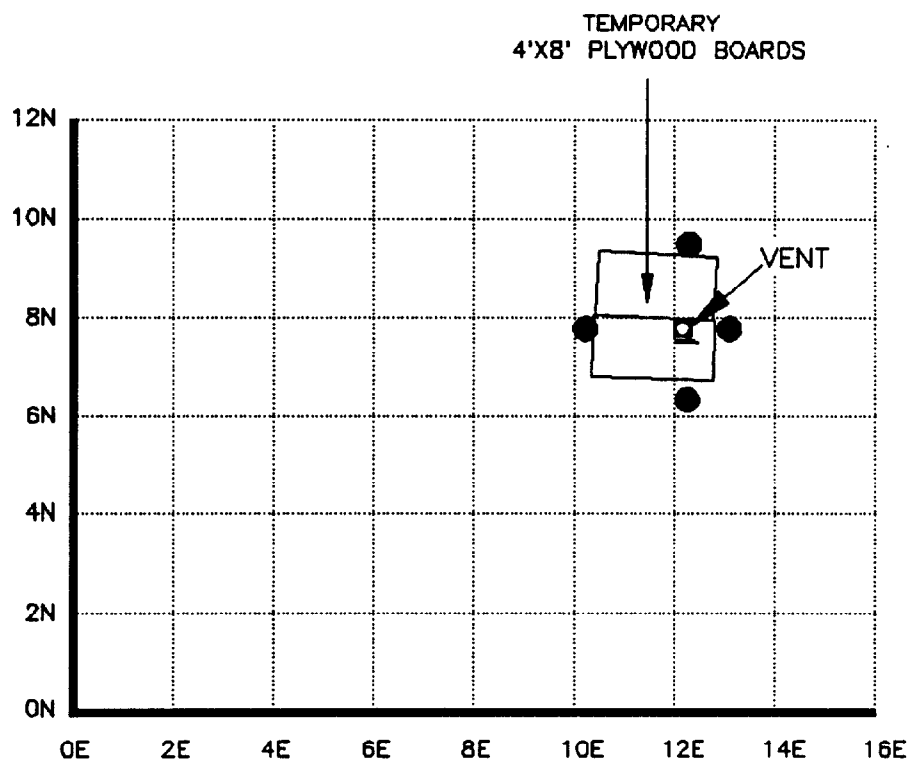


FIGURE 53: Building 23 Roof — Location of Vent Above Upper Storage Area



MEASUREMENT
LOCATIONS

● SINGLE-POINT

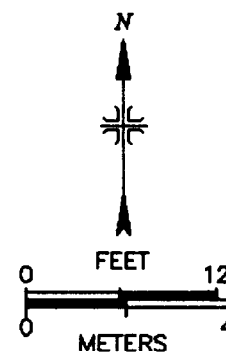


FIGURE 54: Building 23, Southwest Corner of Roof, Vent Opening –
Measurement Locations

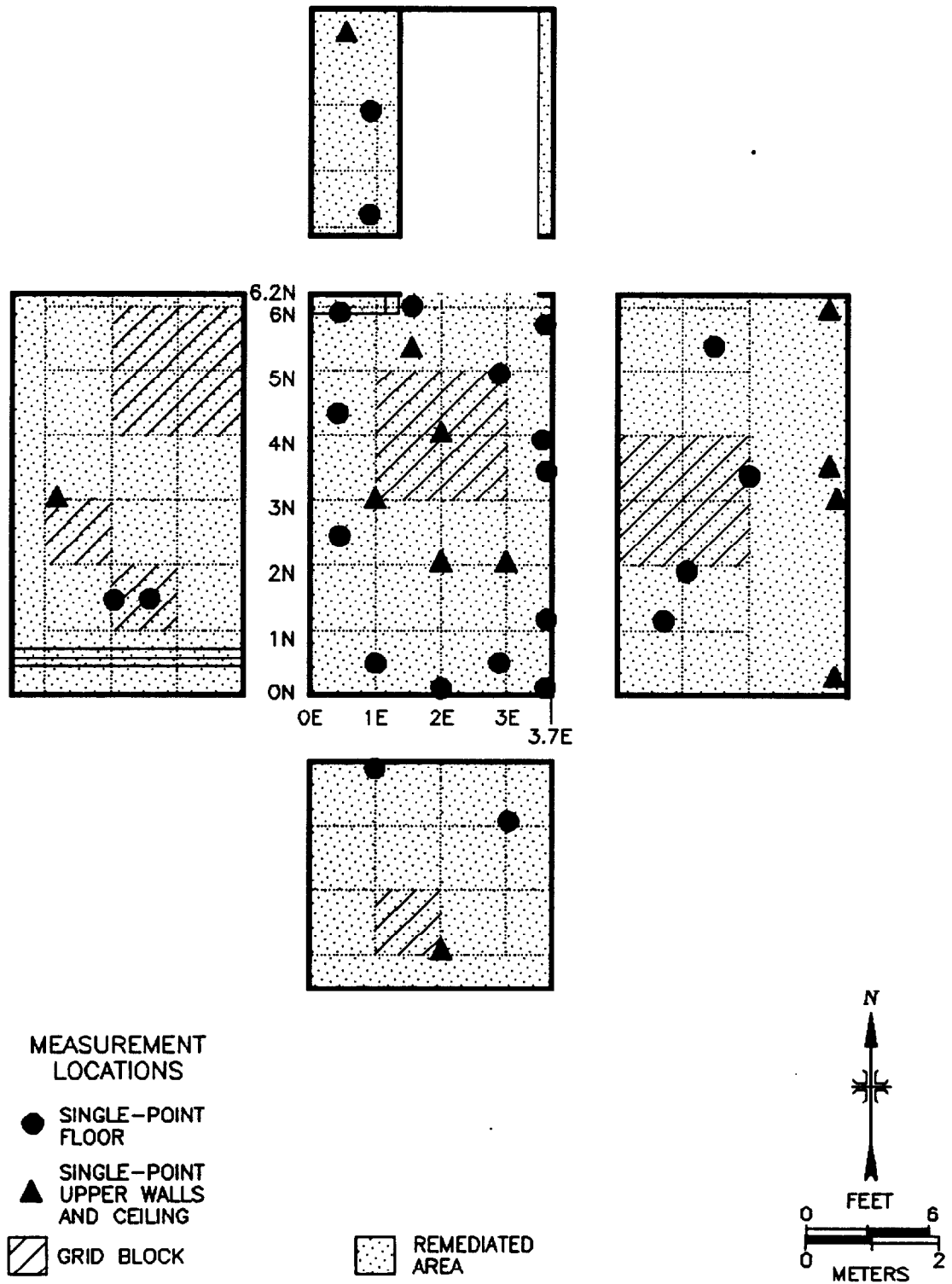


FIGURE 55: Building 23, Thorium Room – Remediated Areas and Measurement Locations

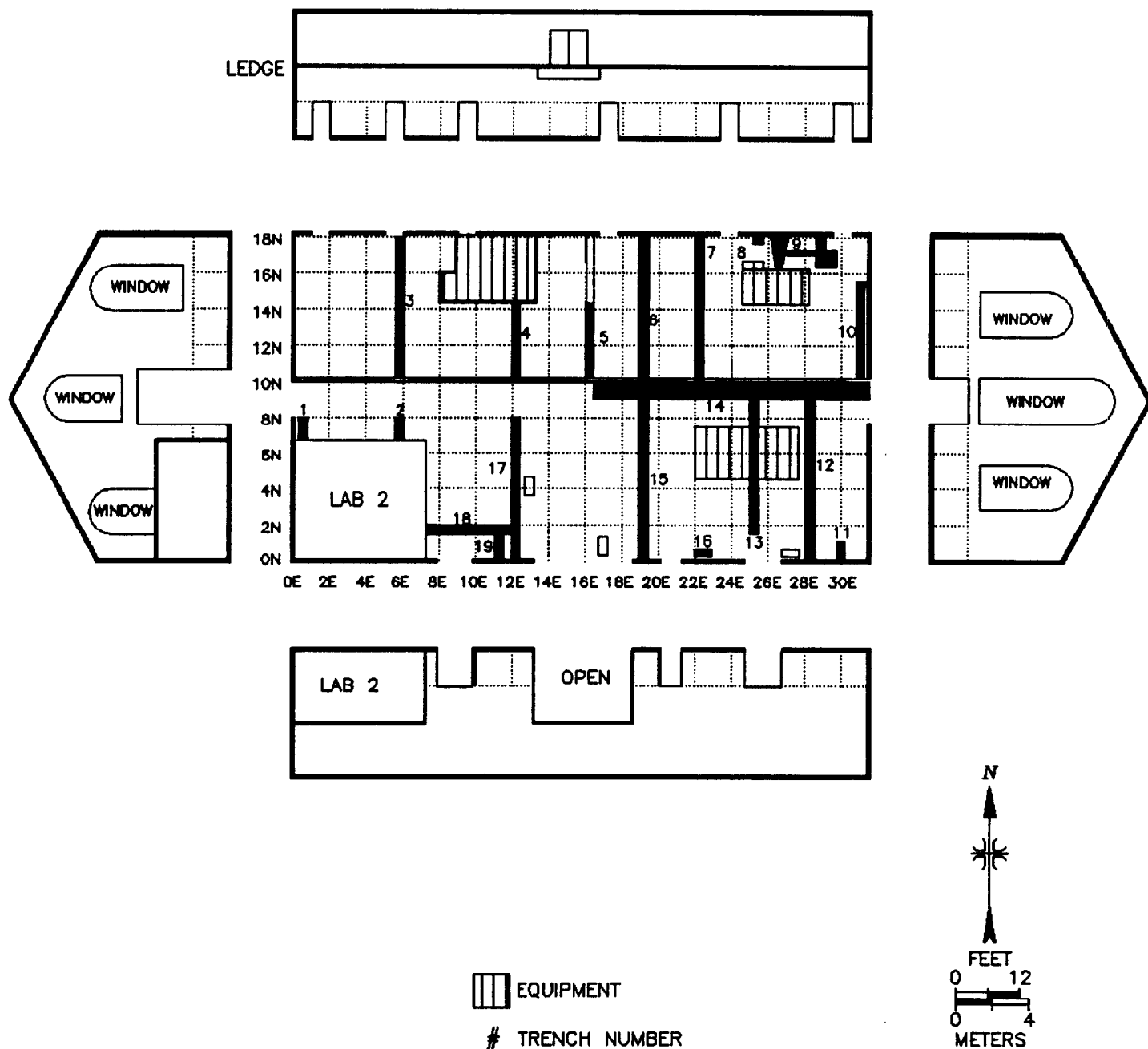


FIGURE 56: Building 23, Lab 1 — Reference Grid and Trench Locations

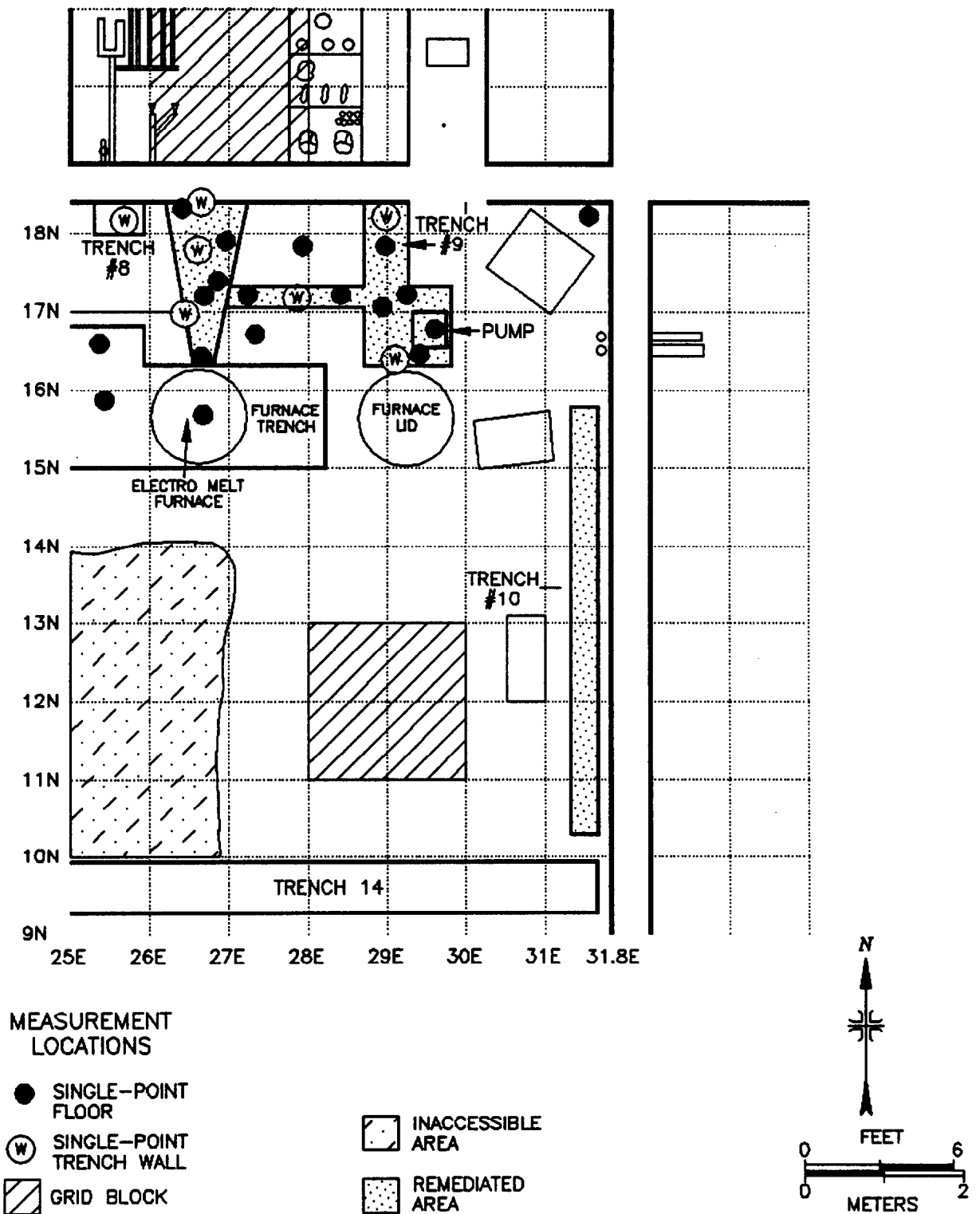


FIGURE 57: Building 23, Lab 1, Northeast Corner, Floor and Lower Walls – Remediated Areas and Measurement Locations

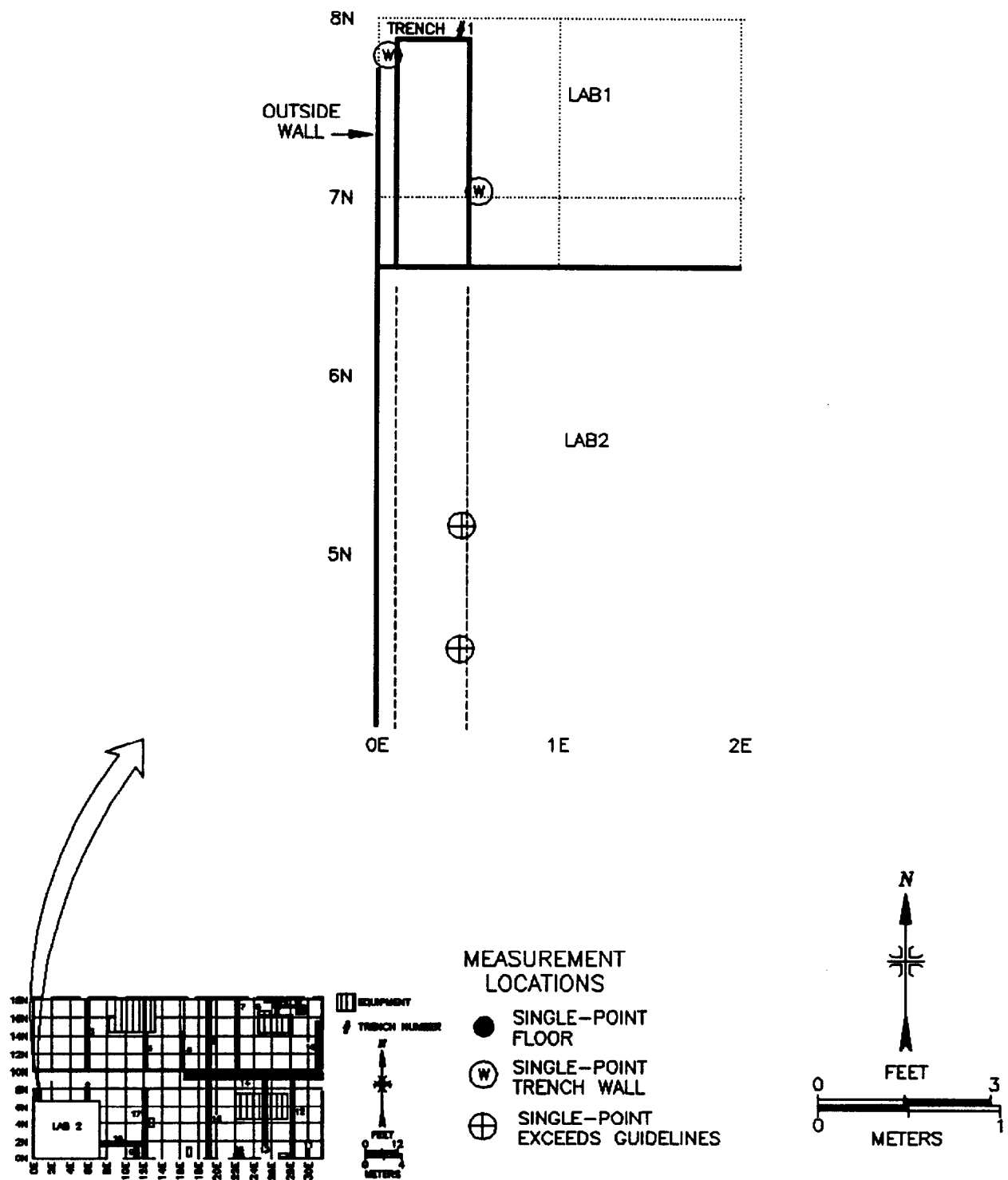


FIGURE 58: Building 23, Lab 1, Trench #1 – Measurement Locations

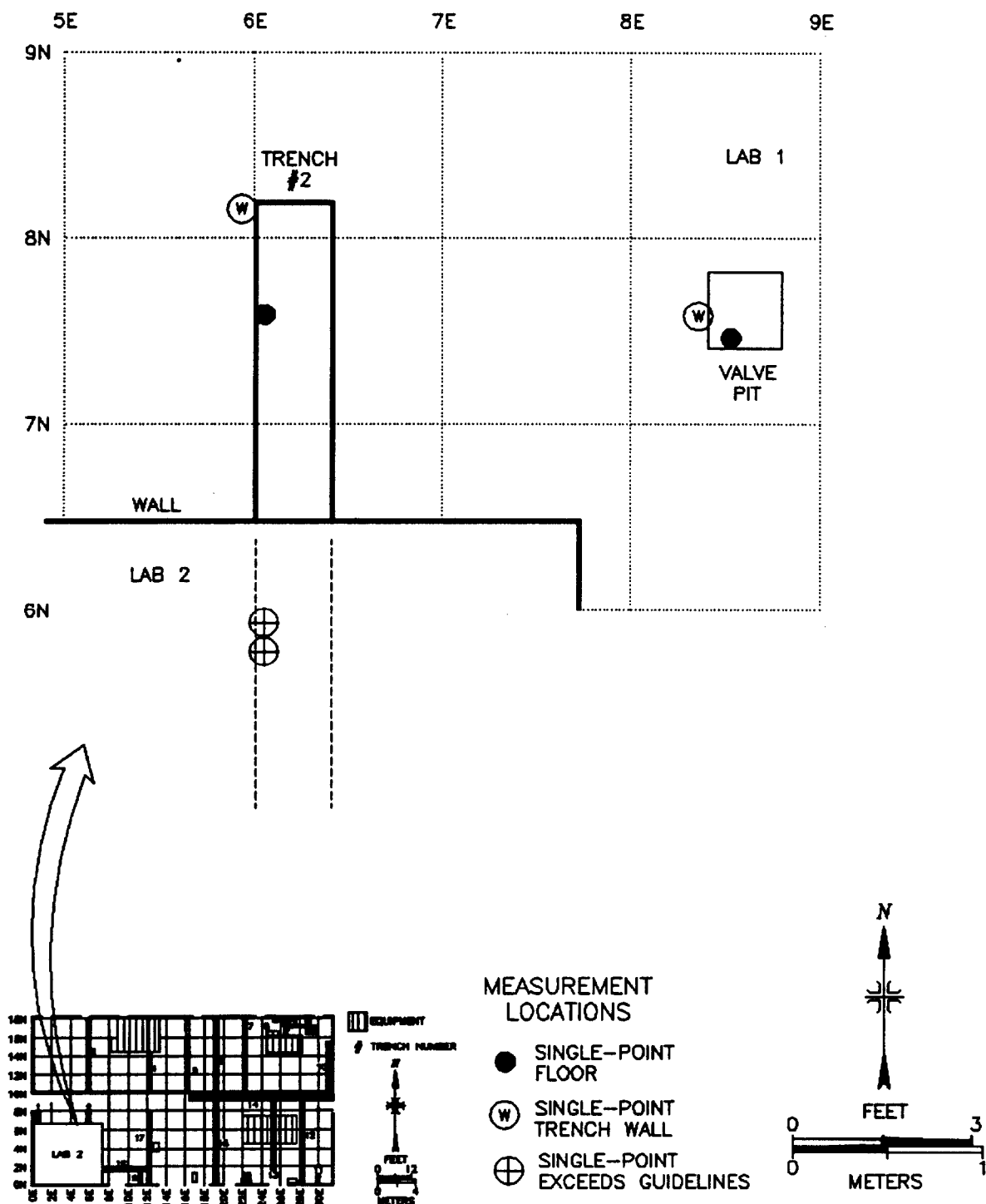


FIGURE 59: Building 23, Lab 1, Trench #2 and Valve Pit – Measurement Locations

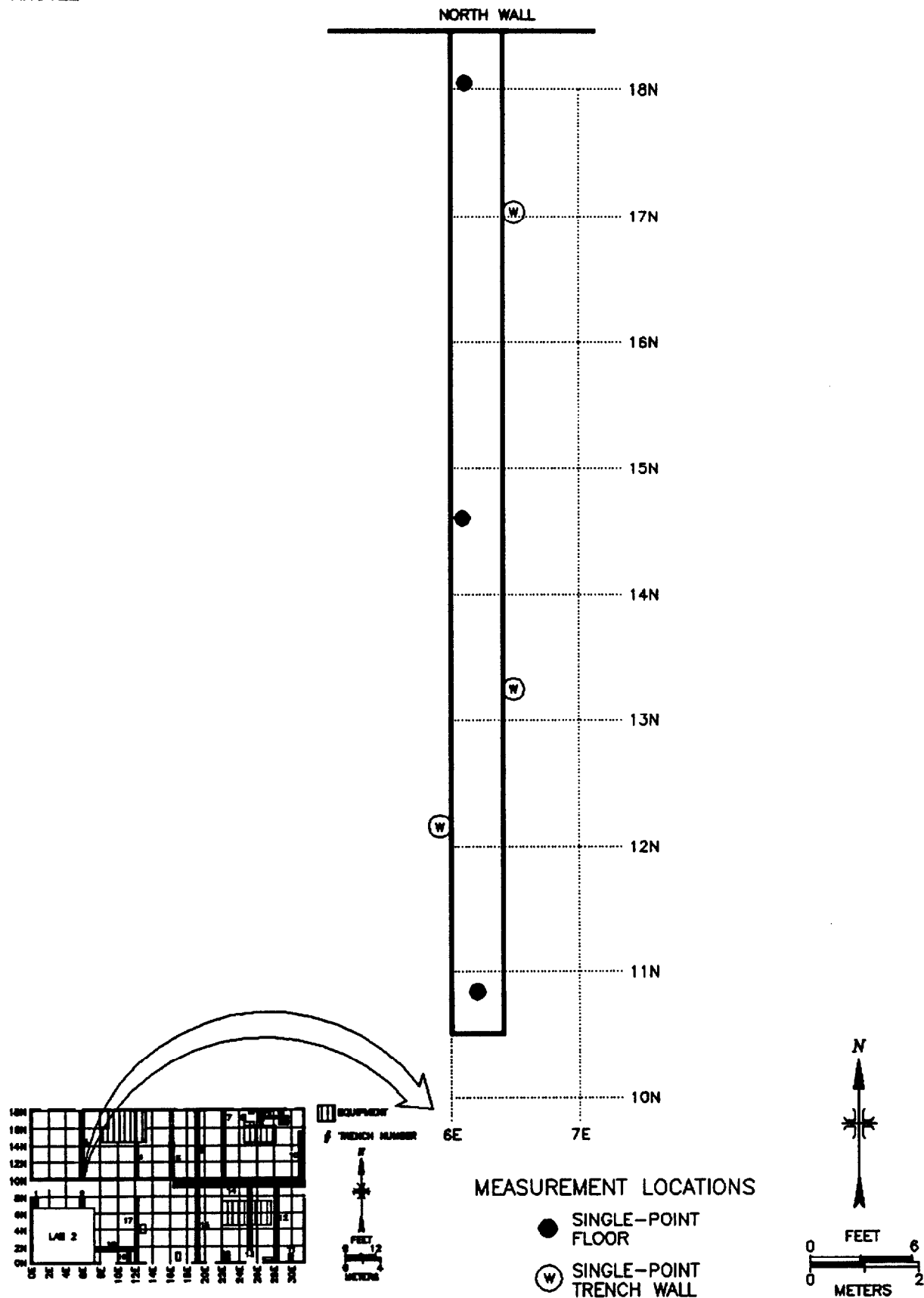


FIGURE 60: Building 23, Lab 1, Trench #3 – Measurement Locations

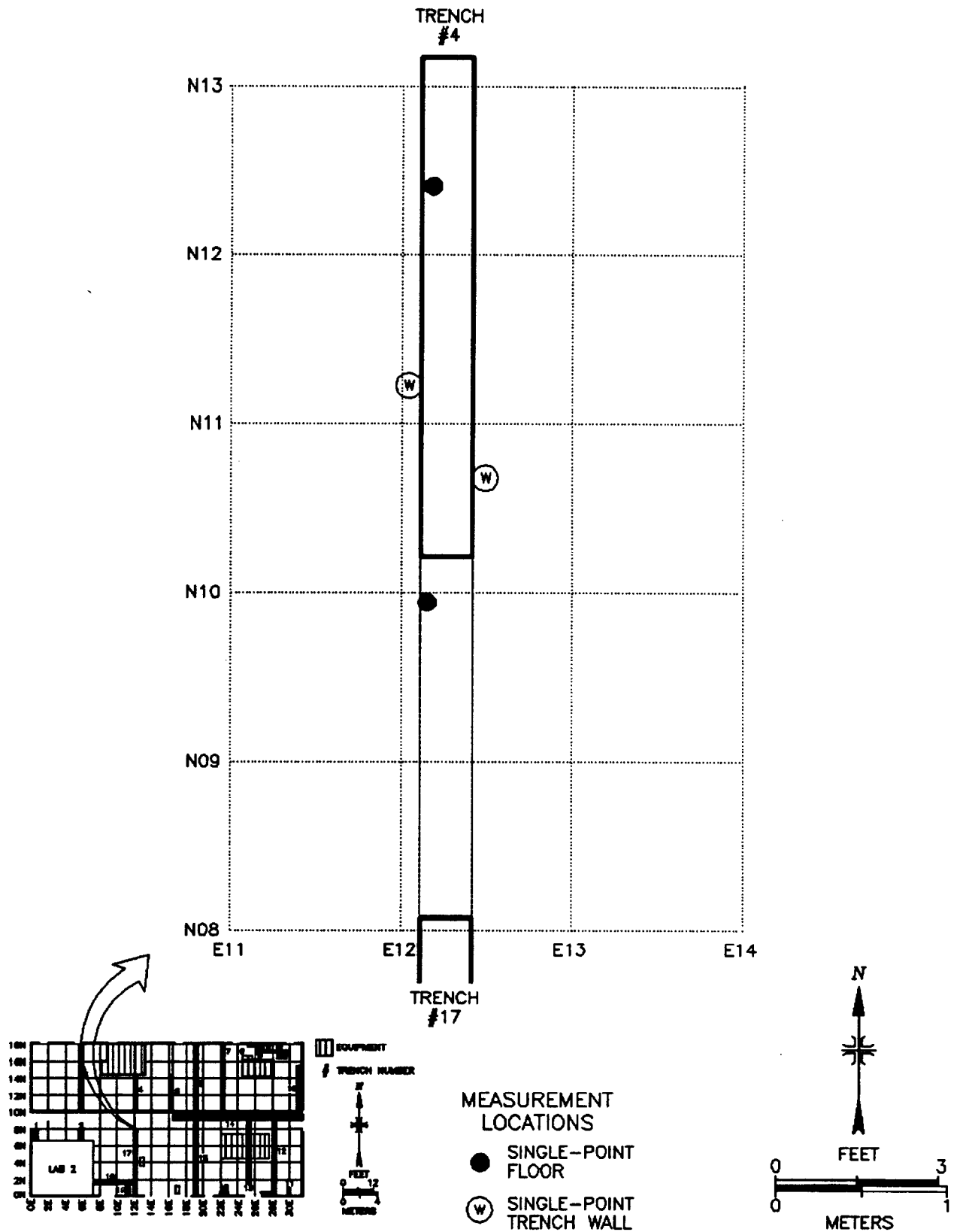


FIGURE 61: Building 23, Lab 1, Trench #4 – Measurement Locations

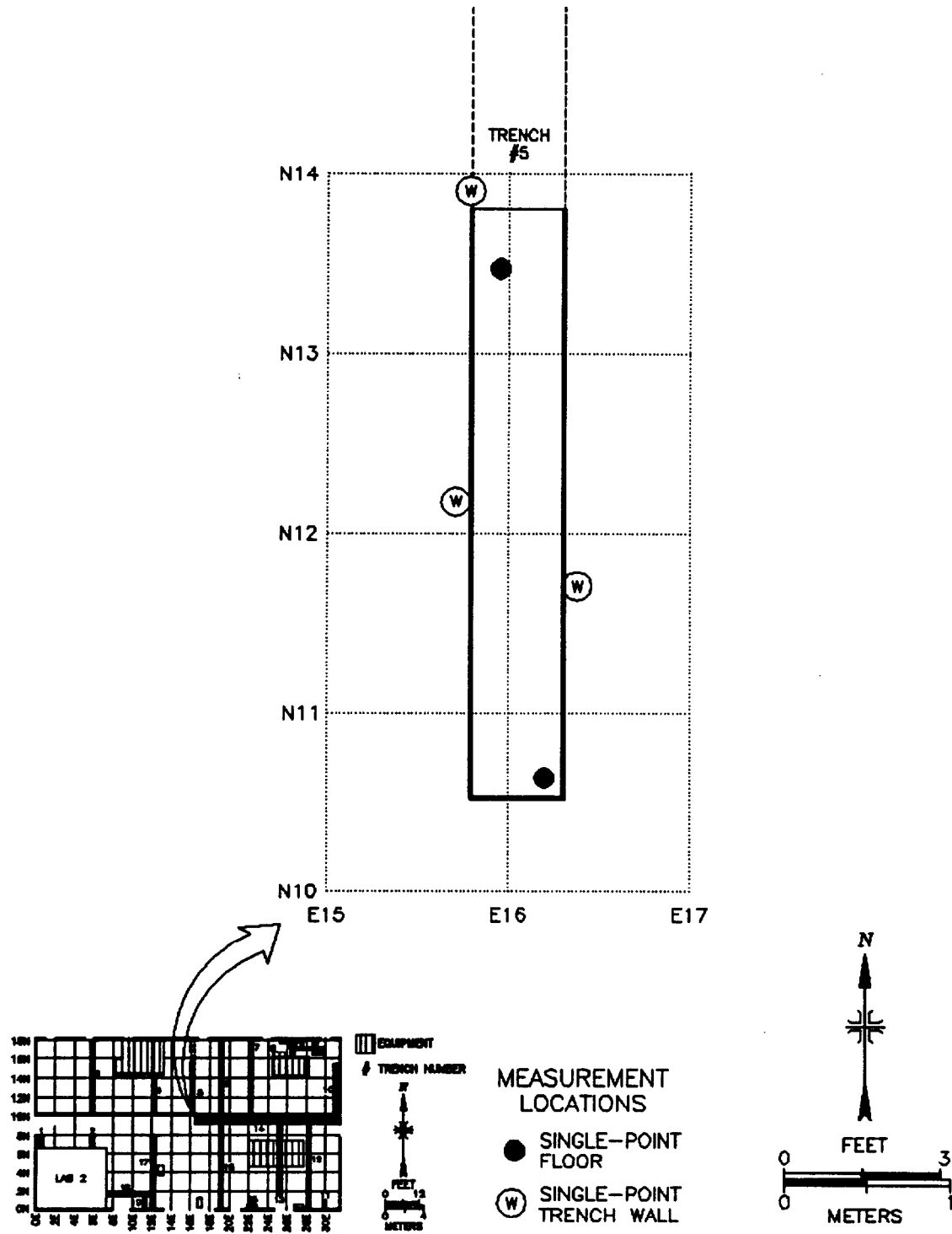


FIGURE 62: Building 23, Lab 1, Trench #5 – Measurement Locations

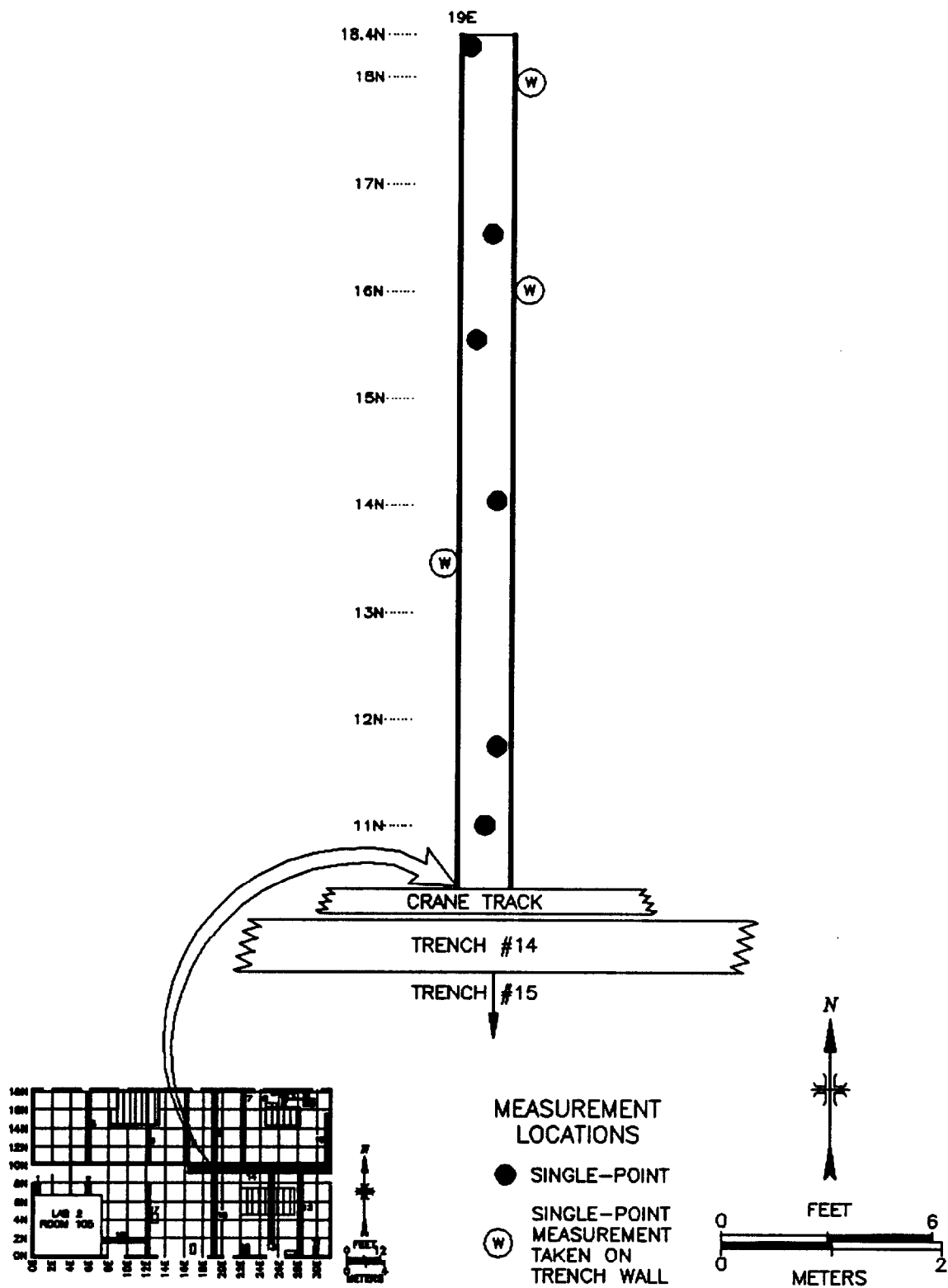


FIGURE 63: Building 23, Lab 1, Trench #6 – Measurement Locations

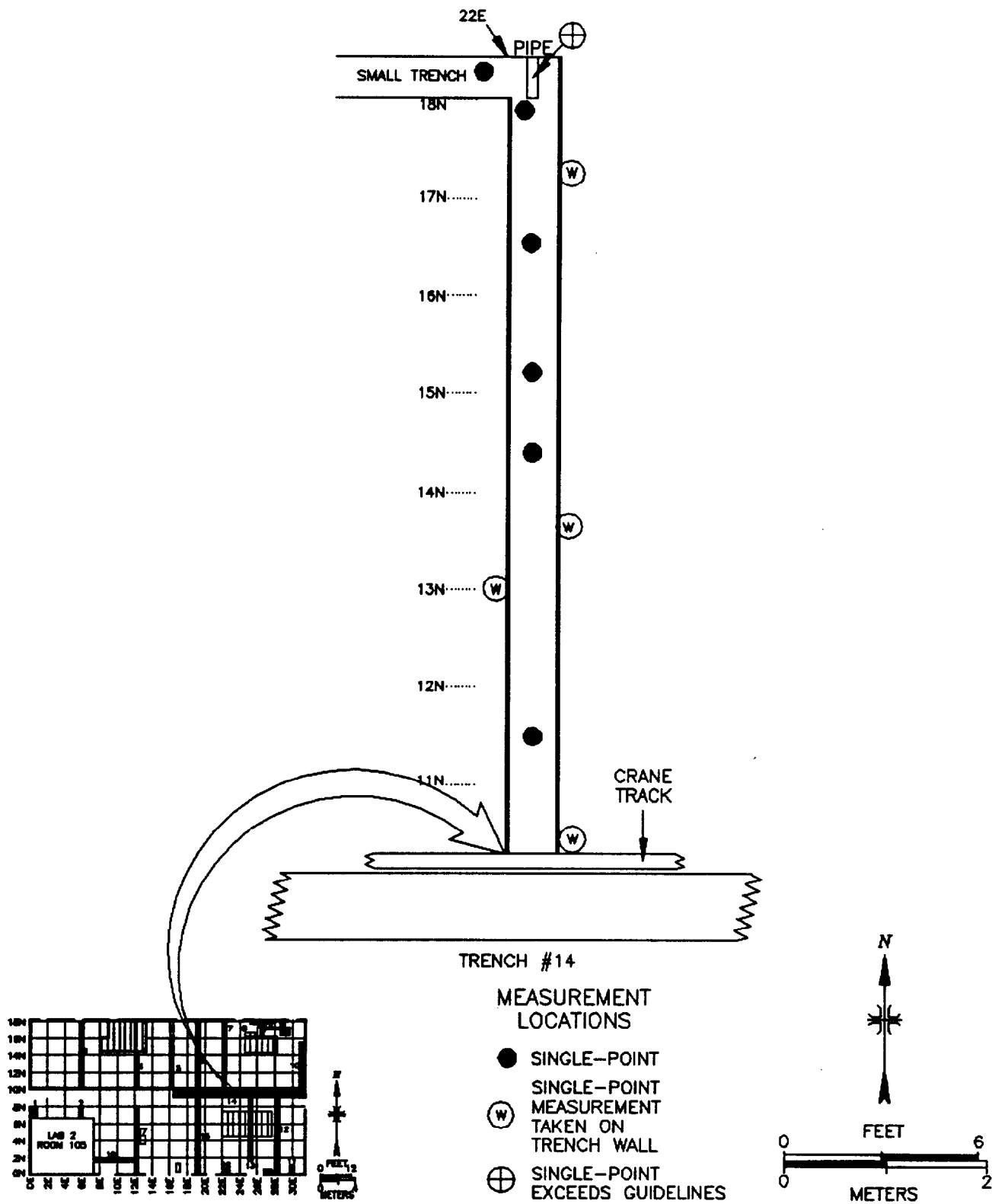


FIGURE 64: Building 23, Lab 1, Trench #7 - Measurement Locations

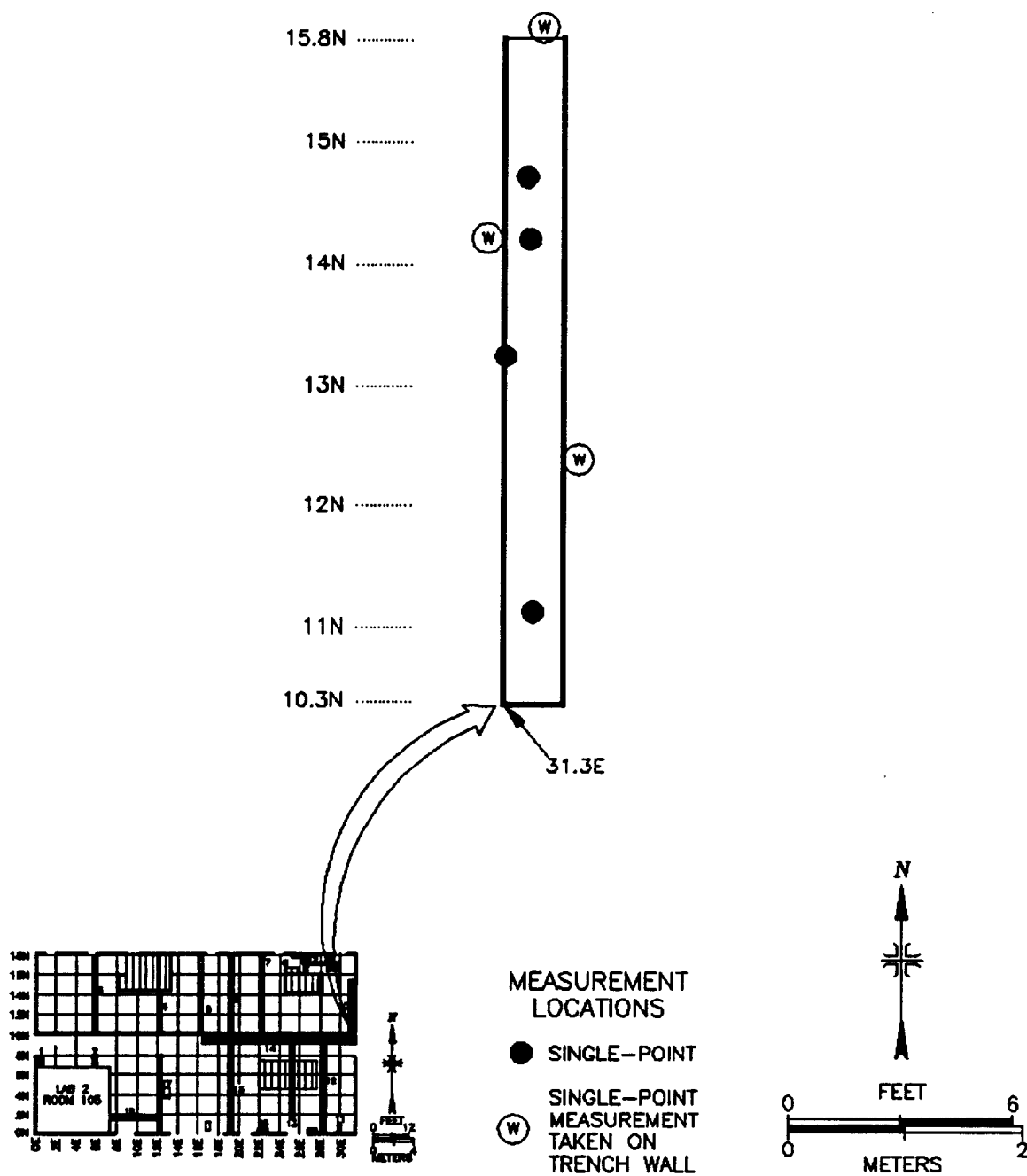


FIGURE 65: Building 23, Lab 1, Trench #10 – Measurement Locations

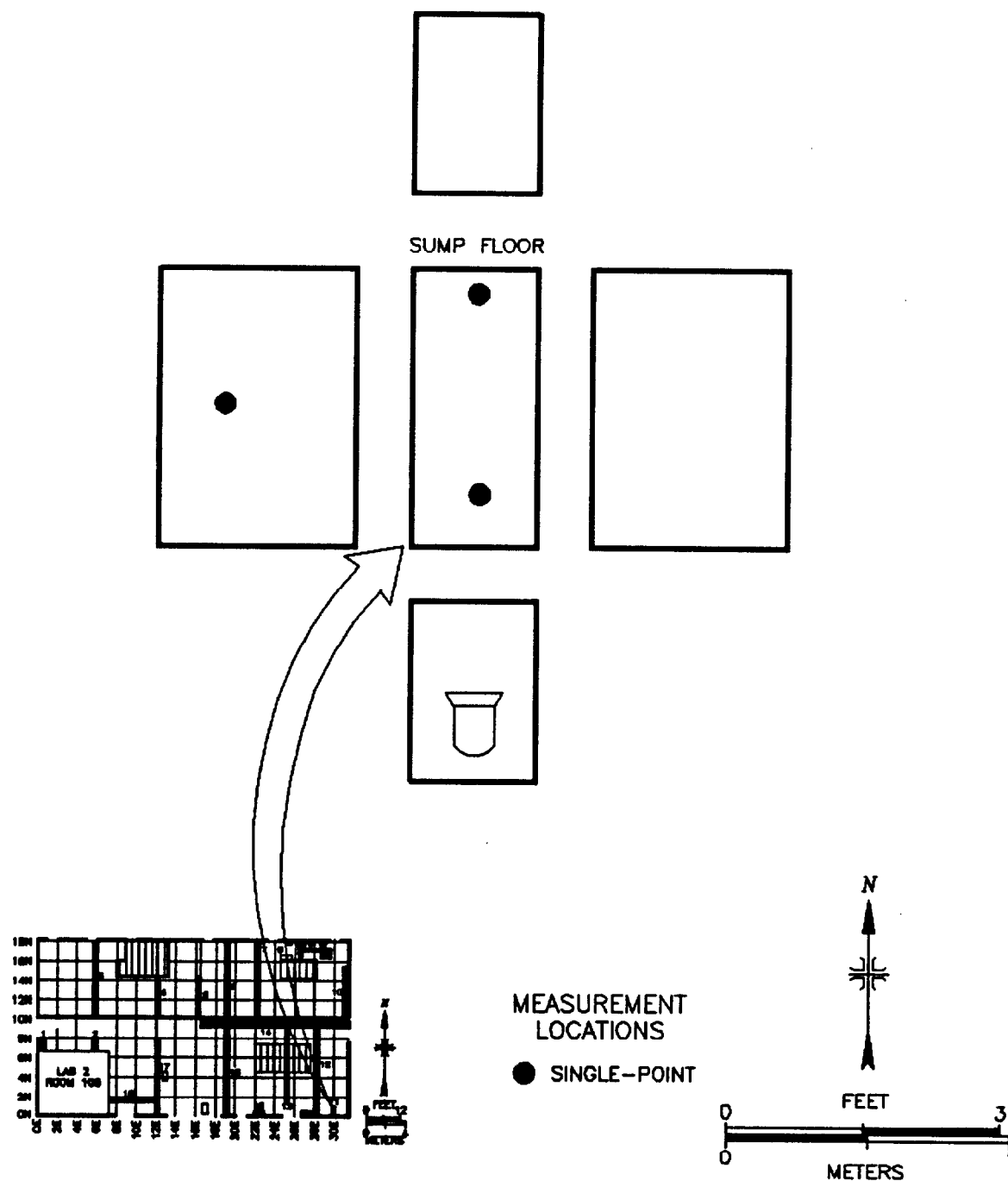


FIGURE 66: Building 23, Lab 1, Trench #11 (Sump) – Measurement Locations

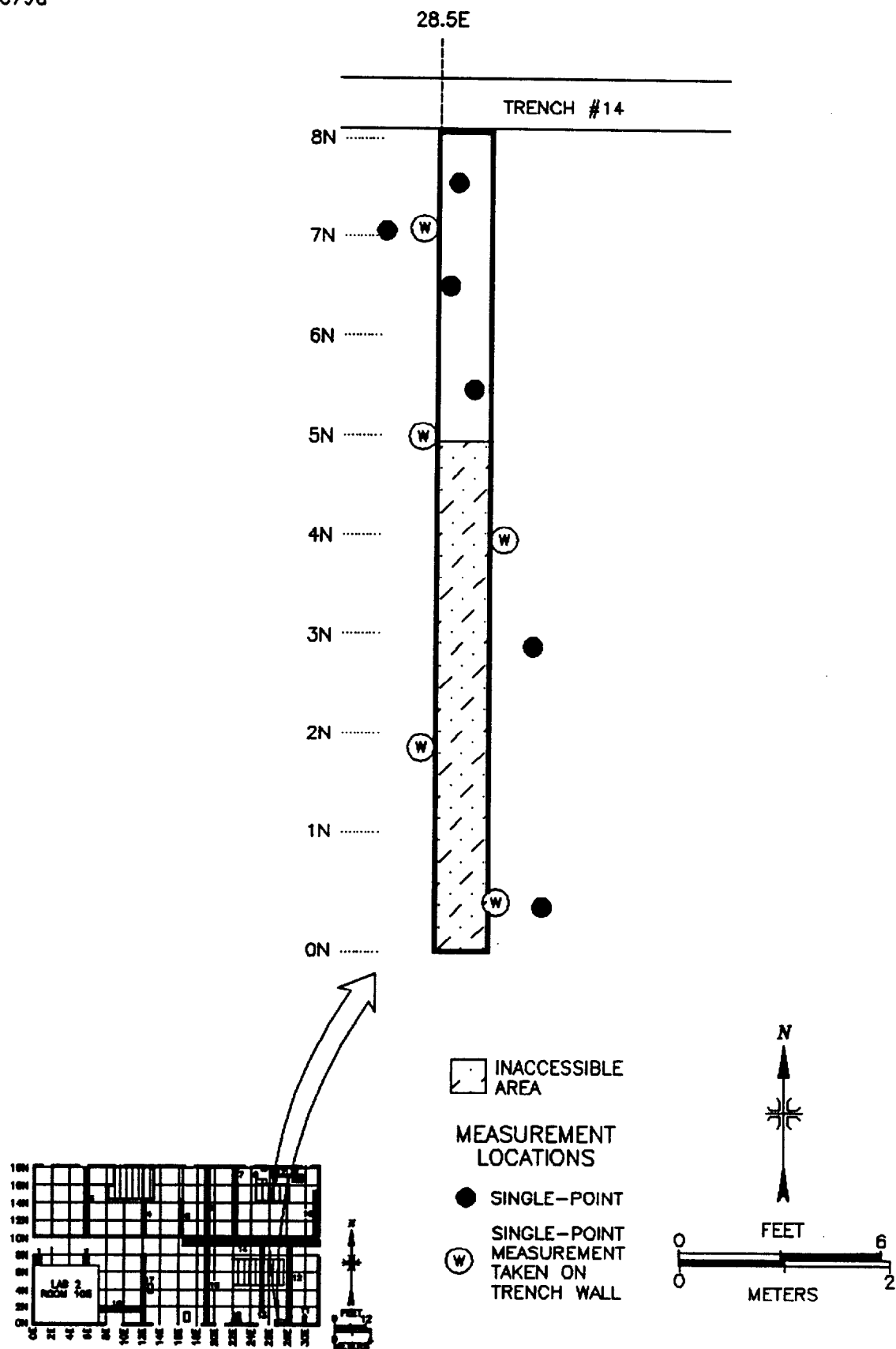


FIGURE 67: Building 23, Lab 1, Trench #12 – Measurement Locations

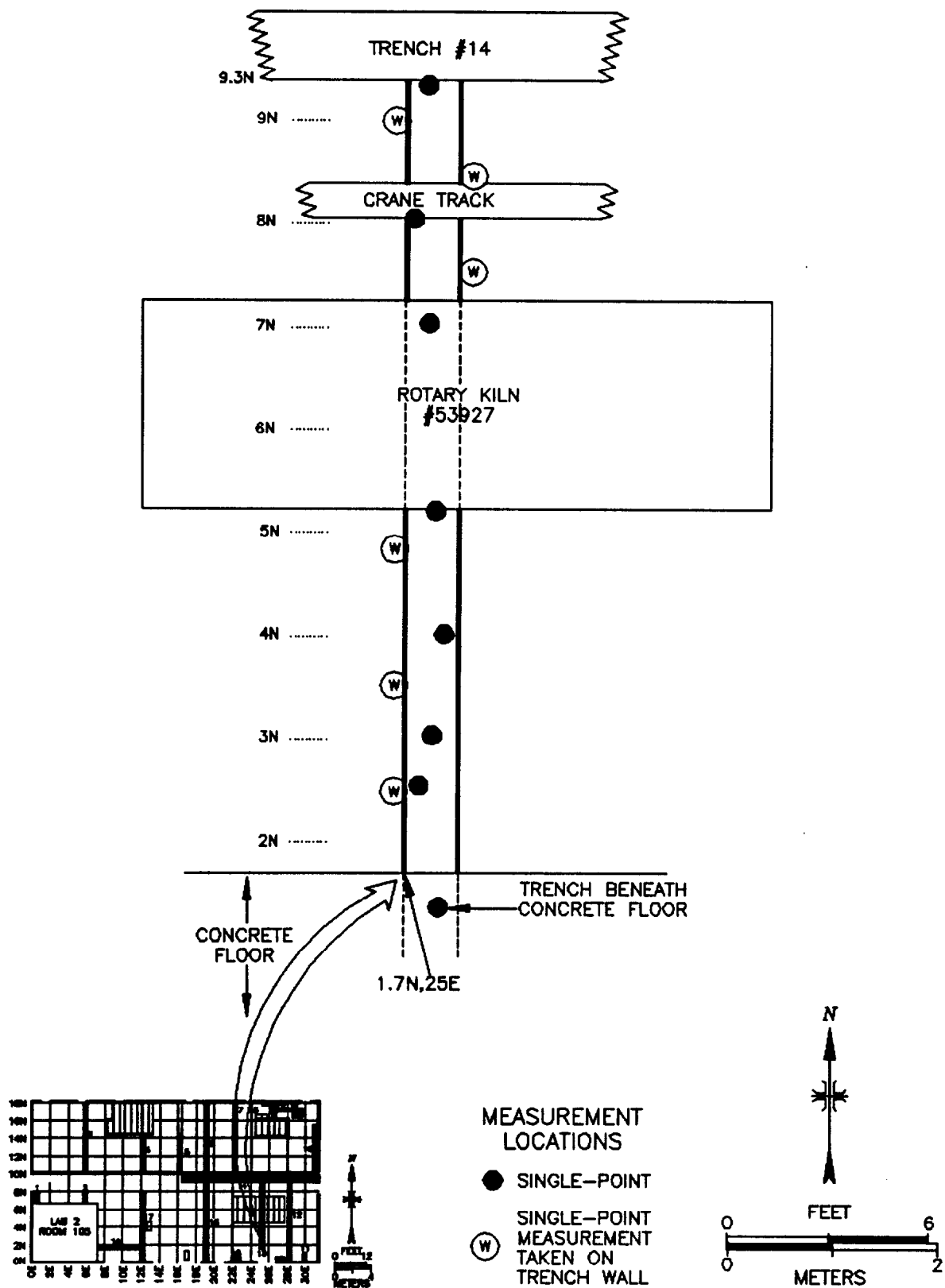
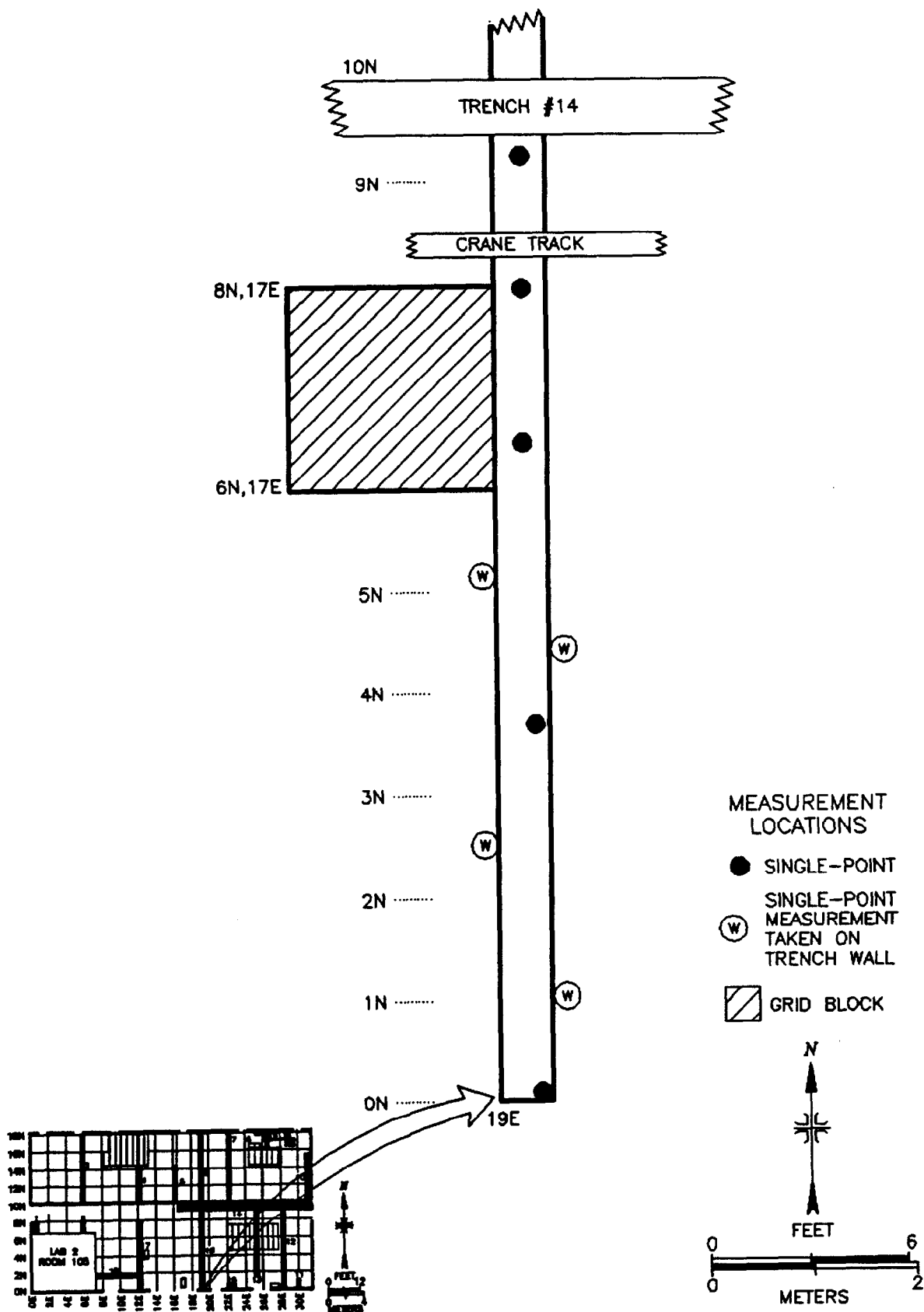


FIGURE 68: Building 23, Lab 1, Trench #13 – Measurement Locations



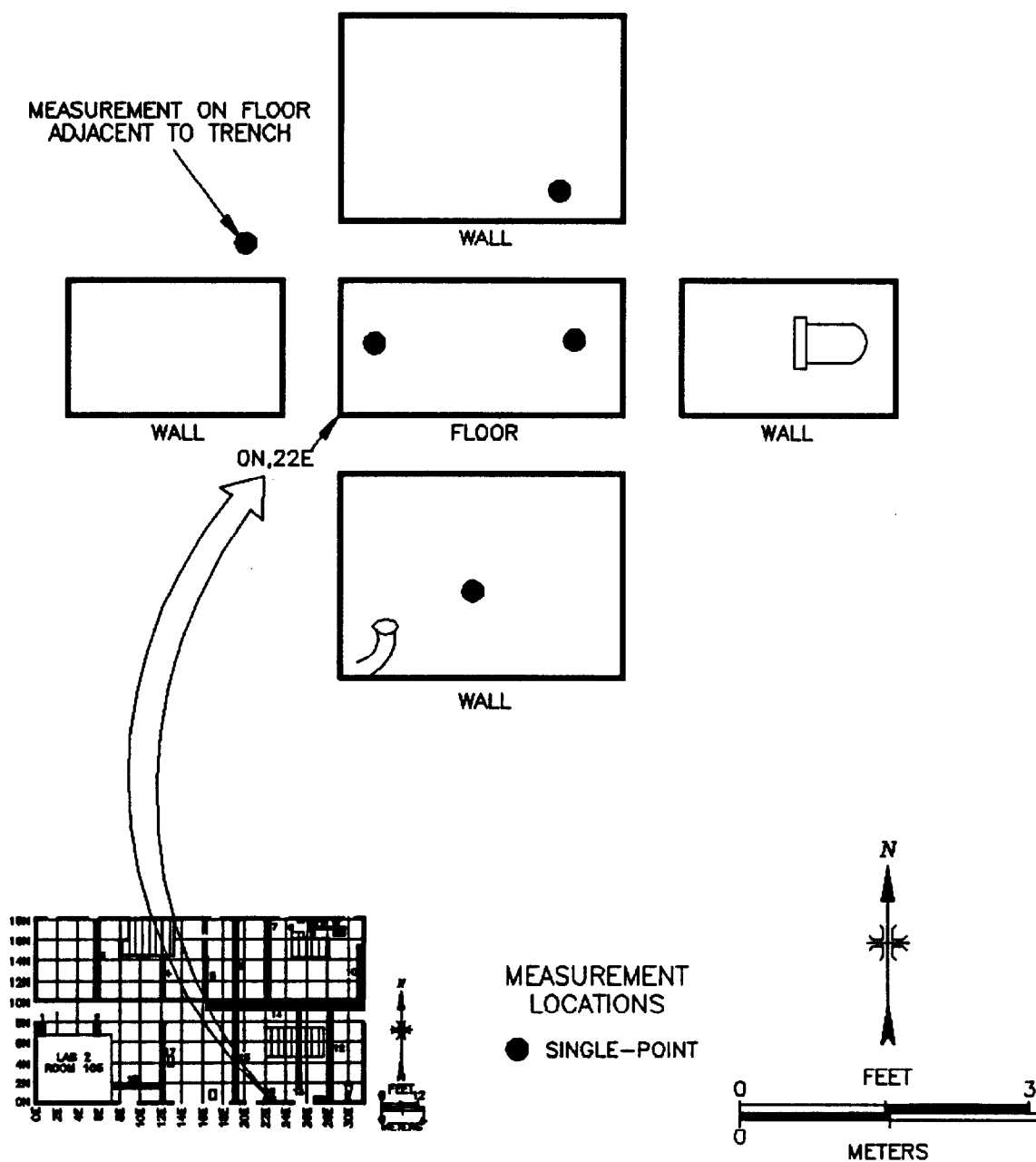


FIGURE 70: Building 23, Lab 1, Trench #16 (Sump) on South Wall Between Rooms 112 and 113 – Measurement Locations

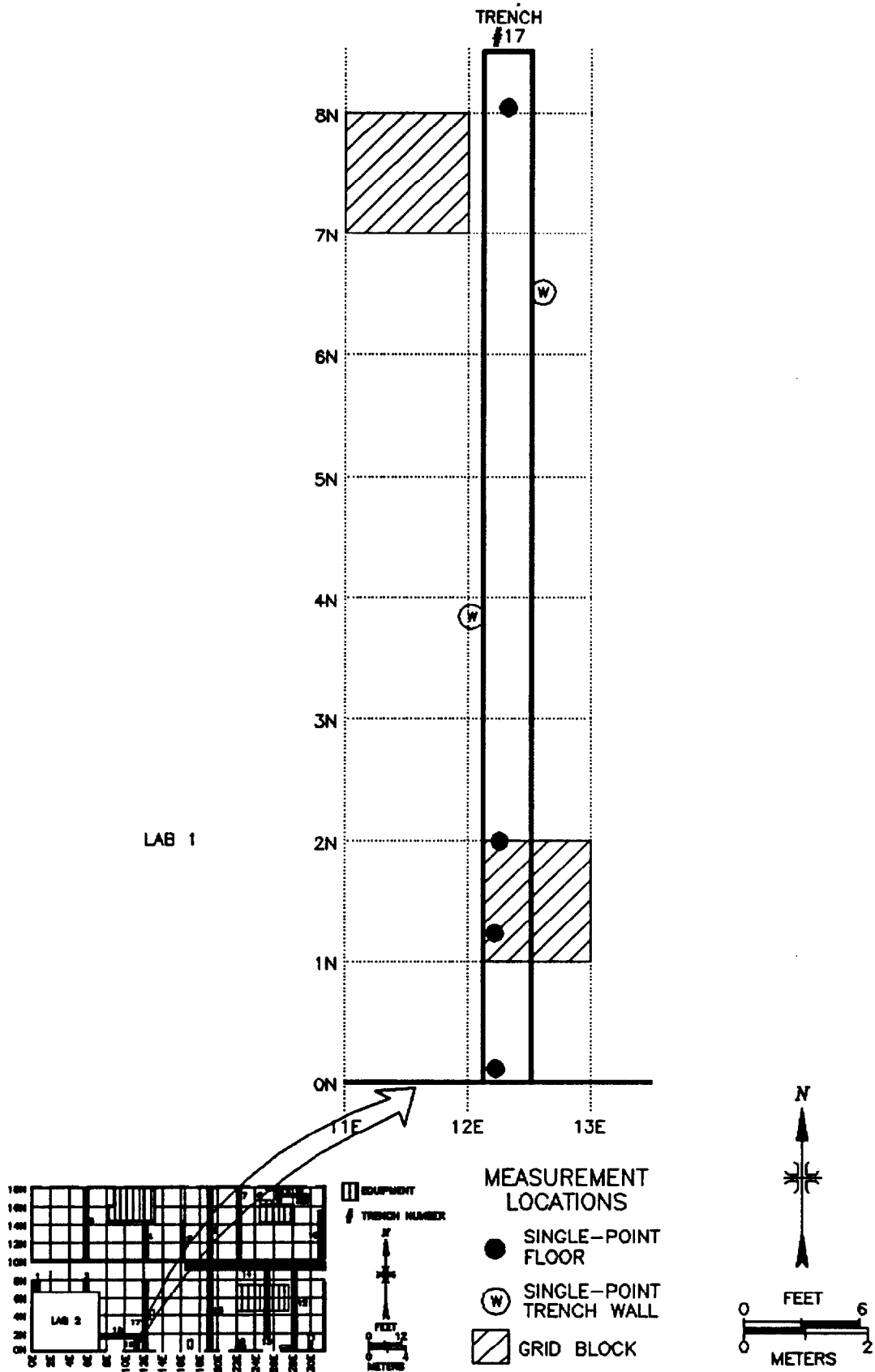


FIGURE 71: Building 23, Lab 1, Trench #17 – Measurement Locations

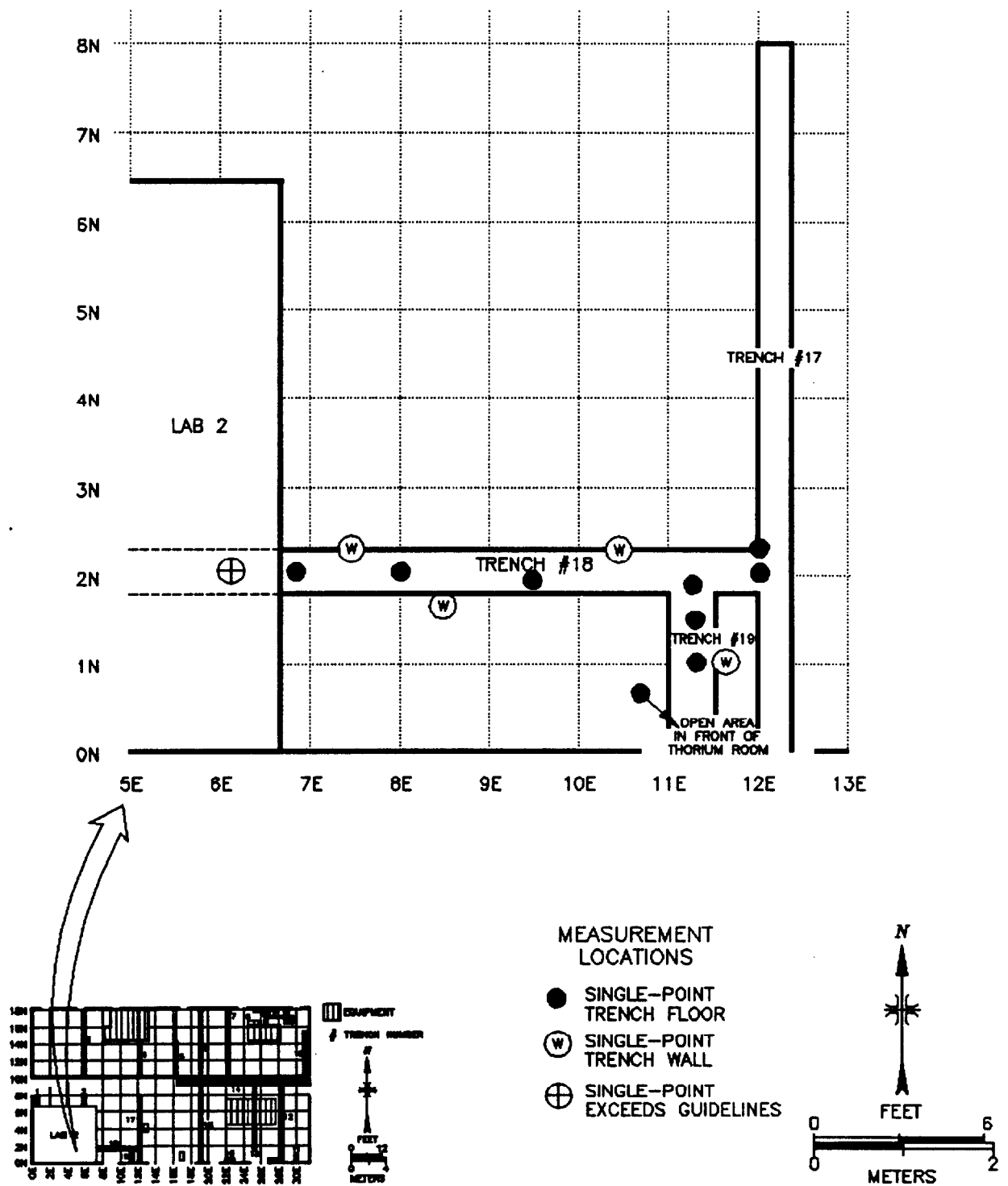
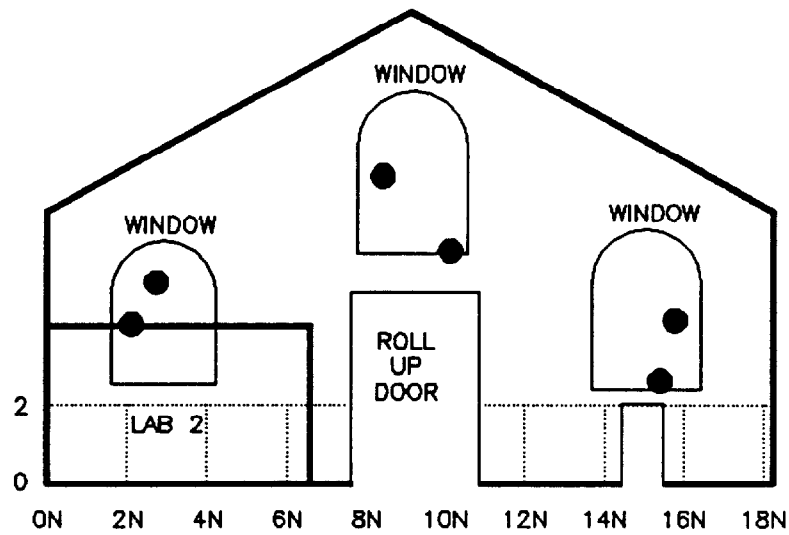


FIGURE 72: Building 23, Lab 1, Trench #18 and 19 - Measurement Locations



MEASUREMENT
LOCATIONS

● SINGLE-POINT

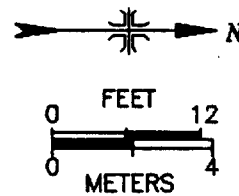


FIGURE 73: Building 23, West Wall Windows – Measurement Locations

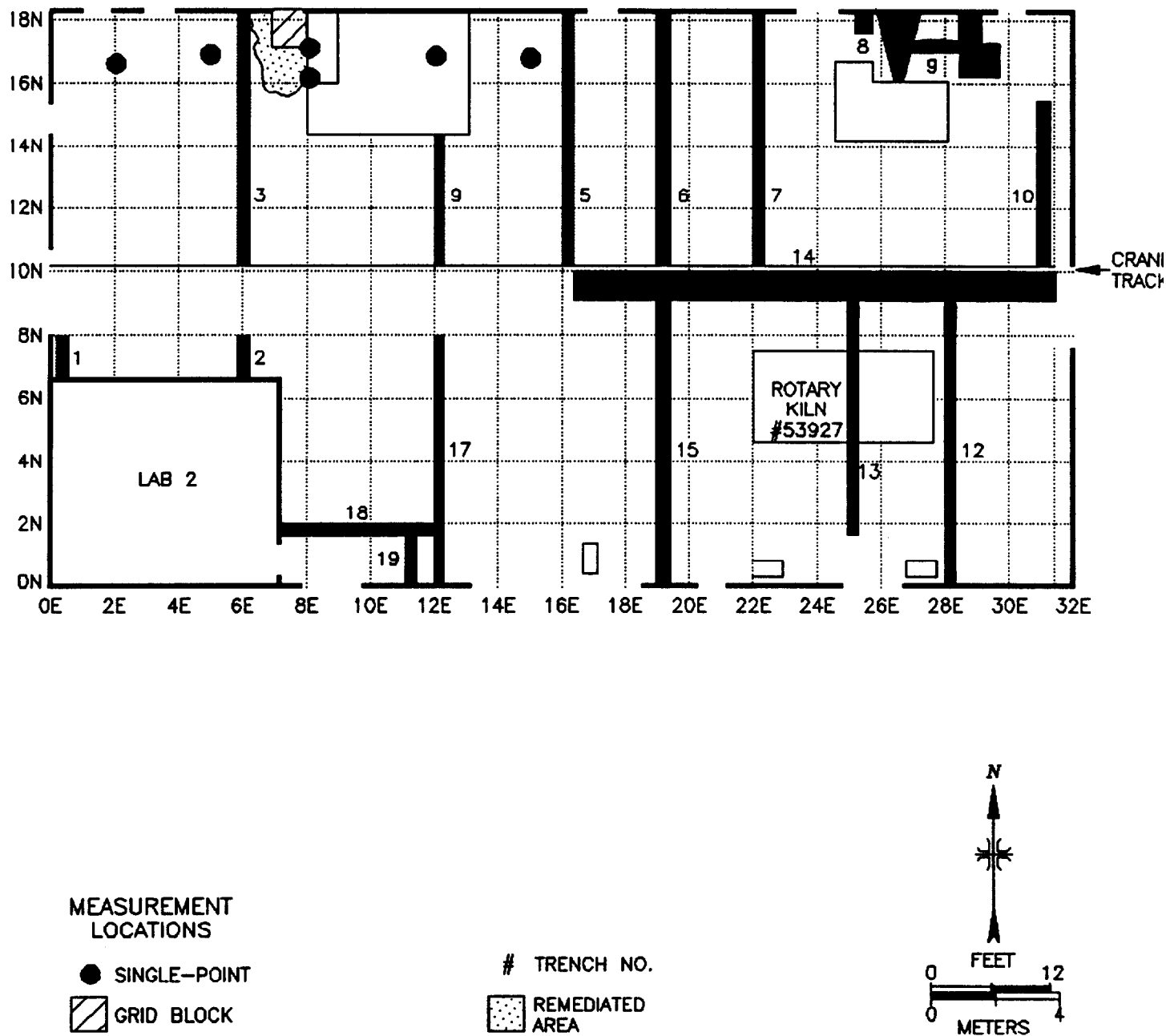


FIGURE 74: Building 23, Lab North Floor – Measurement Locations

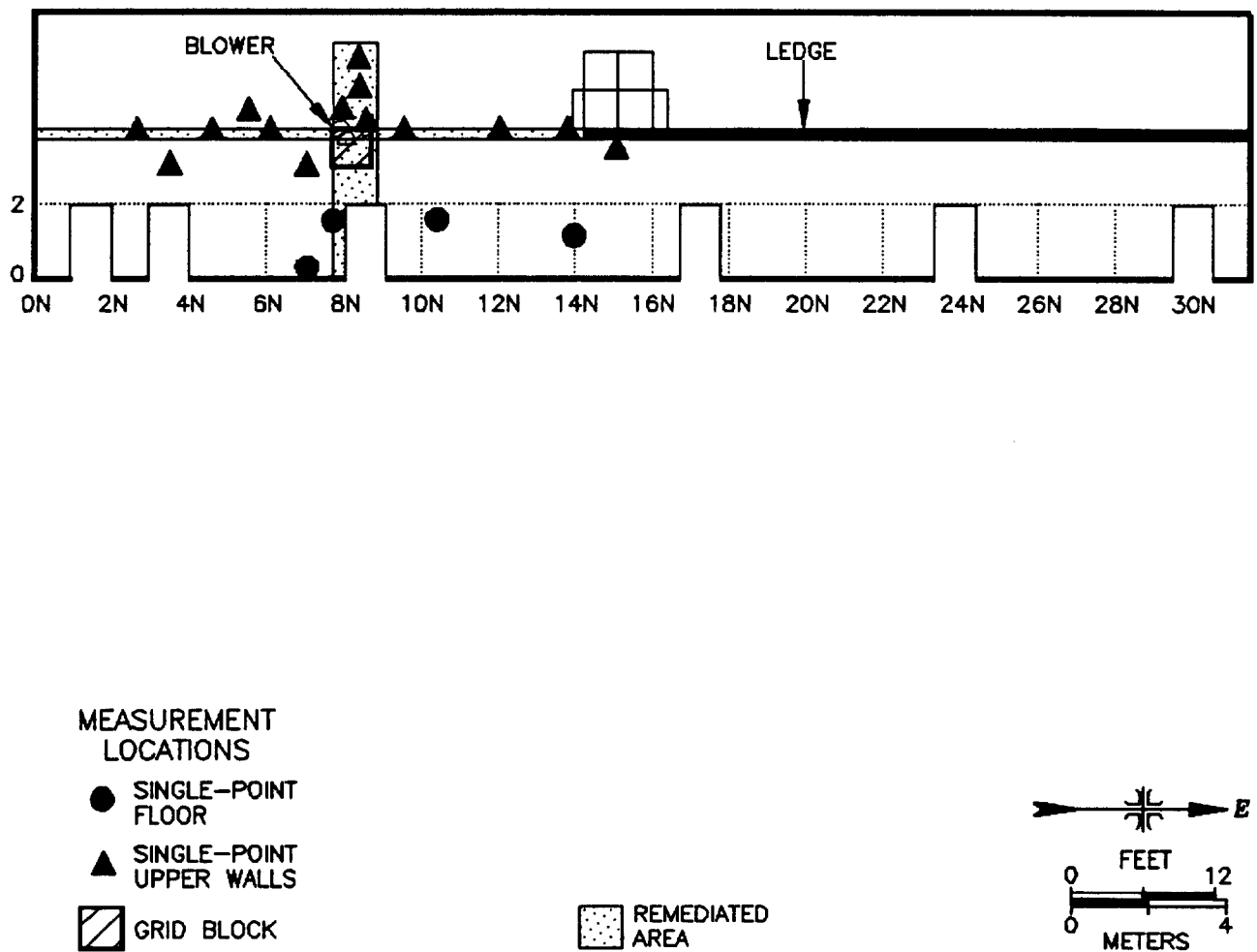


FIGURE 75: Building 23, Lab 1, North Wall – Remediated Areas and Measurement Locations

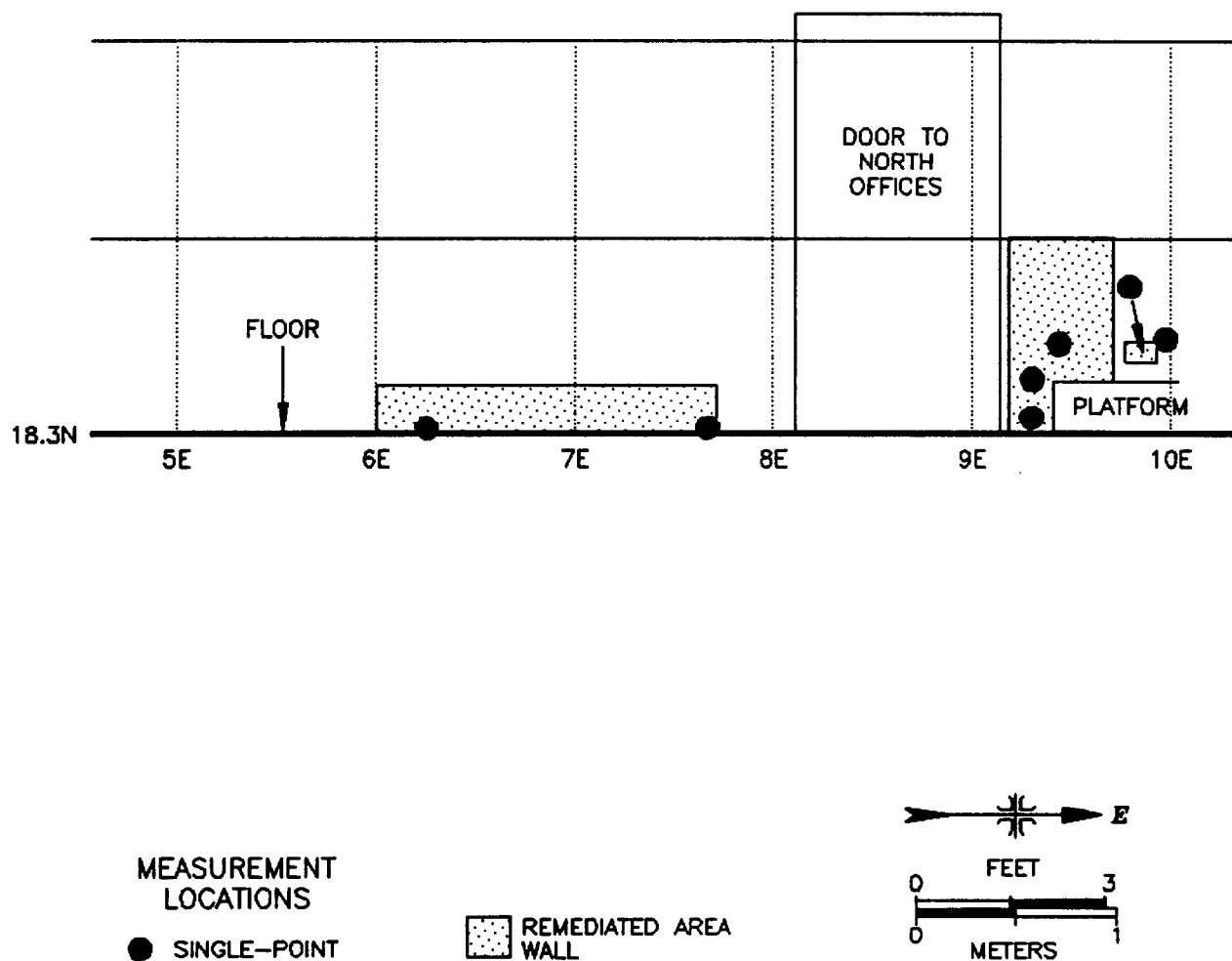


FIGURE 76: Building 23, Lab 1, Enlargement of Lower North Wall
Beneath Blower — Remediated Areas and Measurement
and Sampling Locations

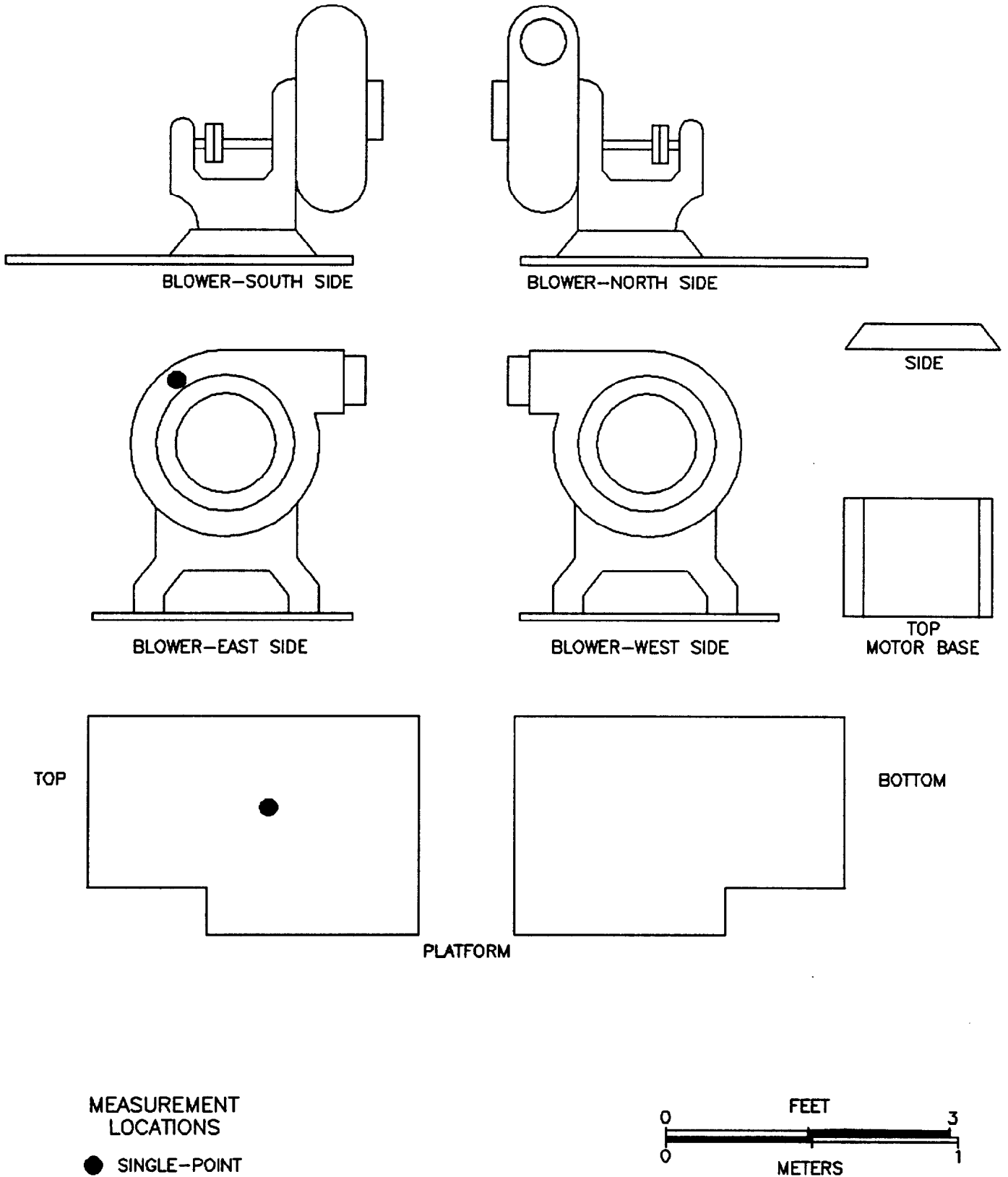


FIGURE 77: Building 23, Lab 1, North Wall Blower – Measurement Locations

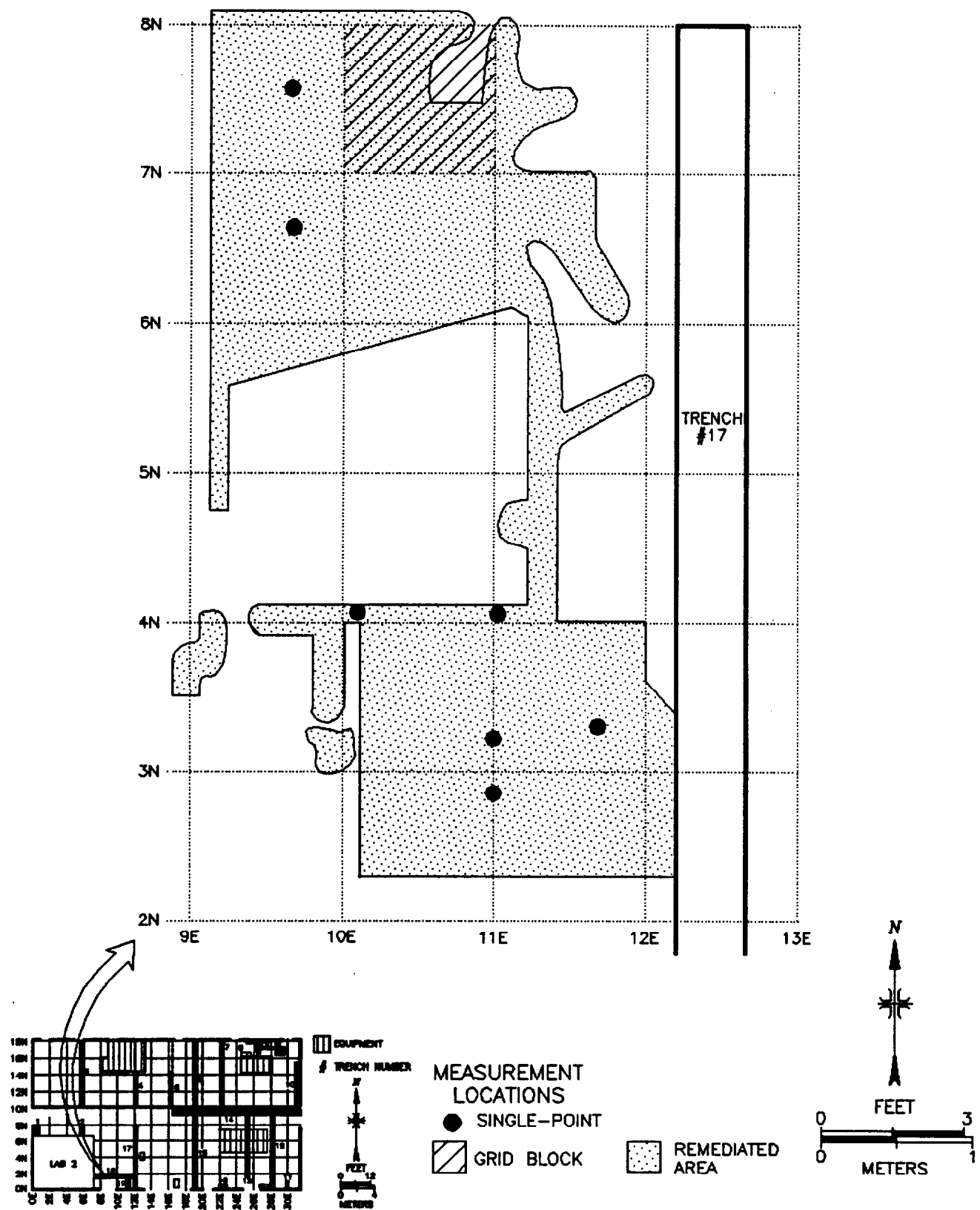


FIGURE 78: Building 23, Lab 1, Floor North of Thorium Room – Remediated Areas and Measurement Locations

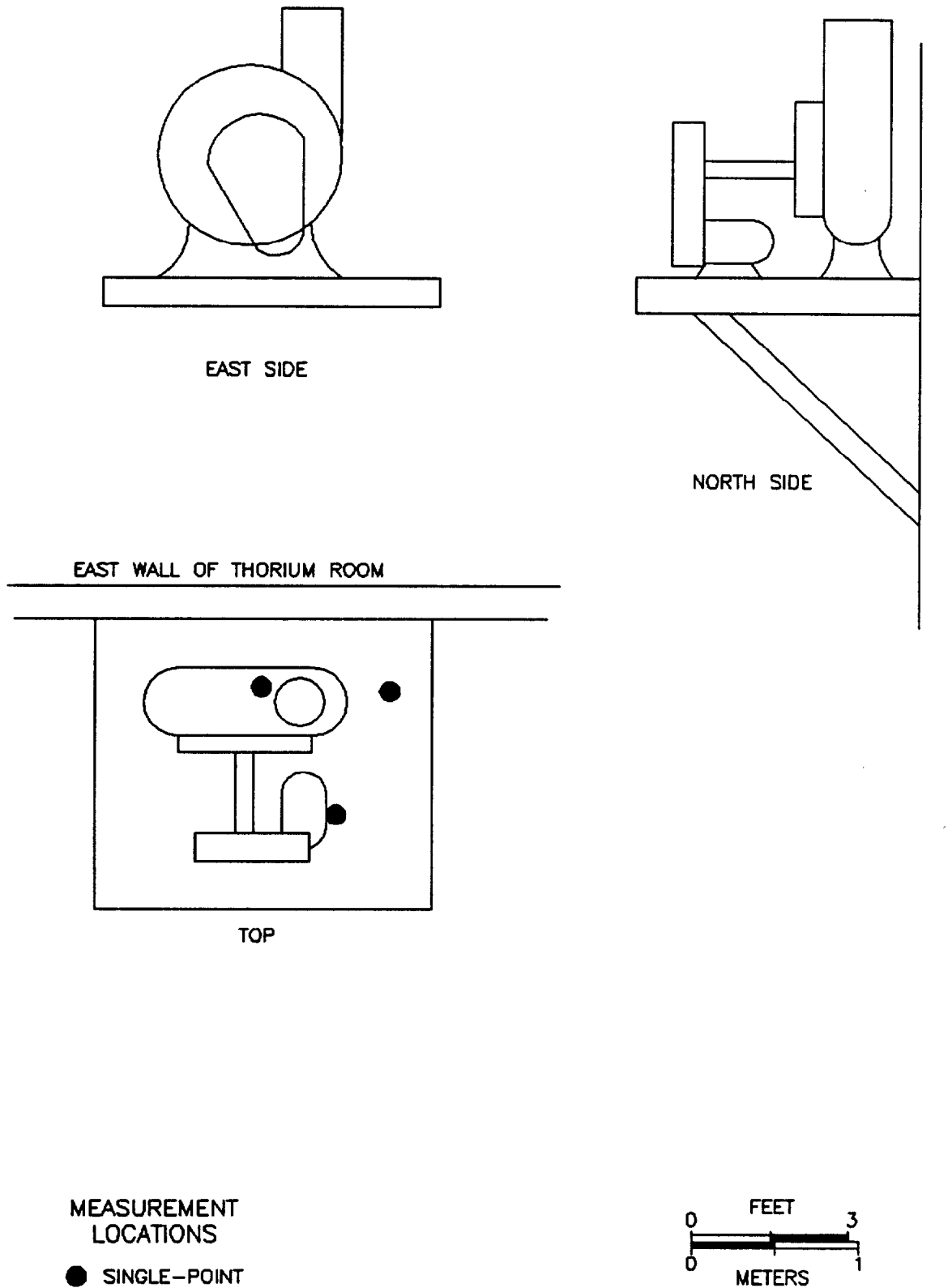


FIGURE 79: Building 23, Lab 1, Blower Outside East Wall of Thorium Room – Measurement Locations

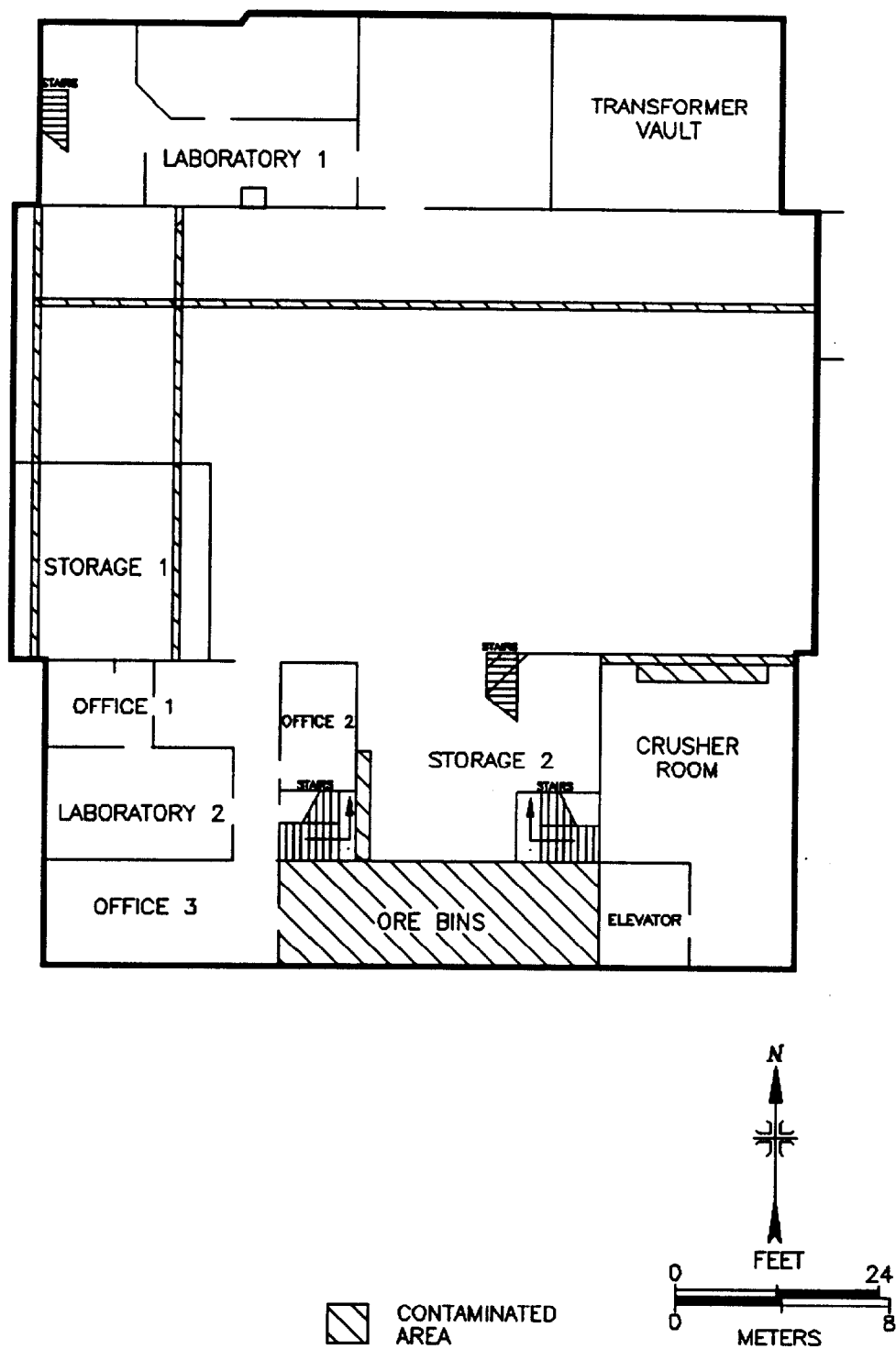


FIGURE 80: Plot Plan of Building 23, Second Floor

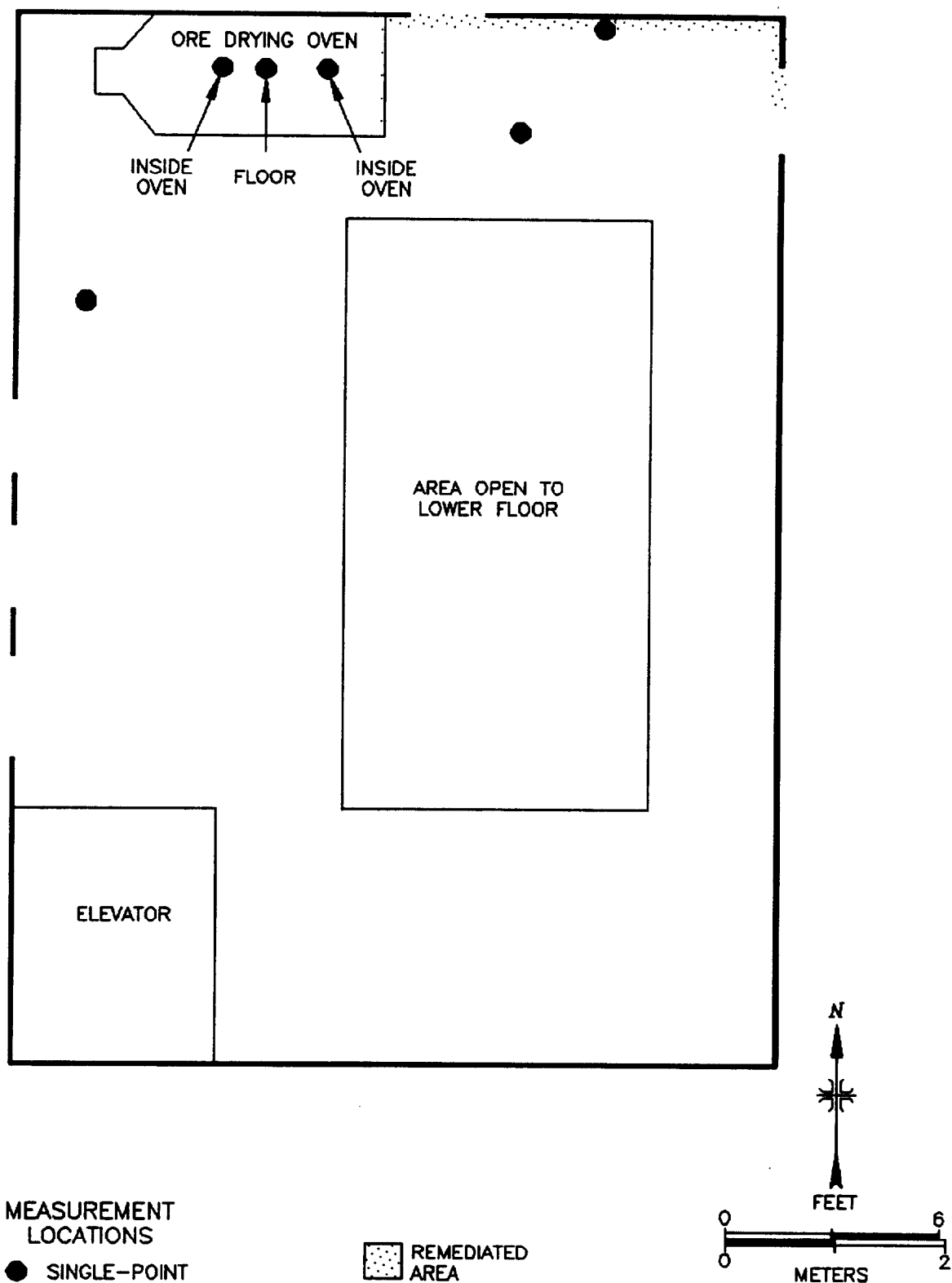


FIGURE 81: Building 23, Crusher Room, Second Floor — Remediated Areas and Measurement Locations

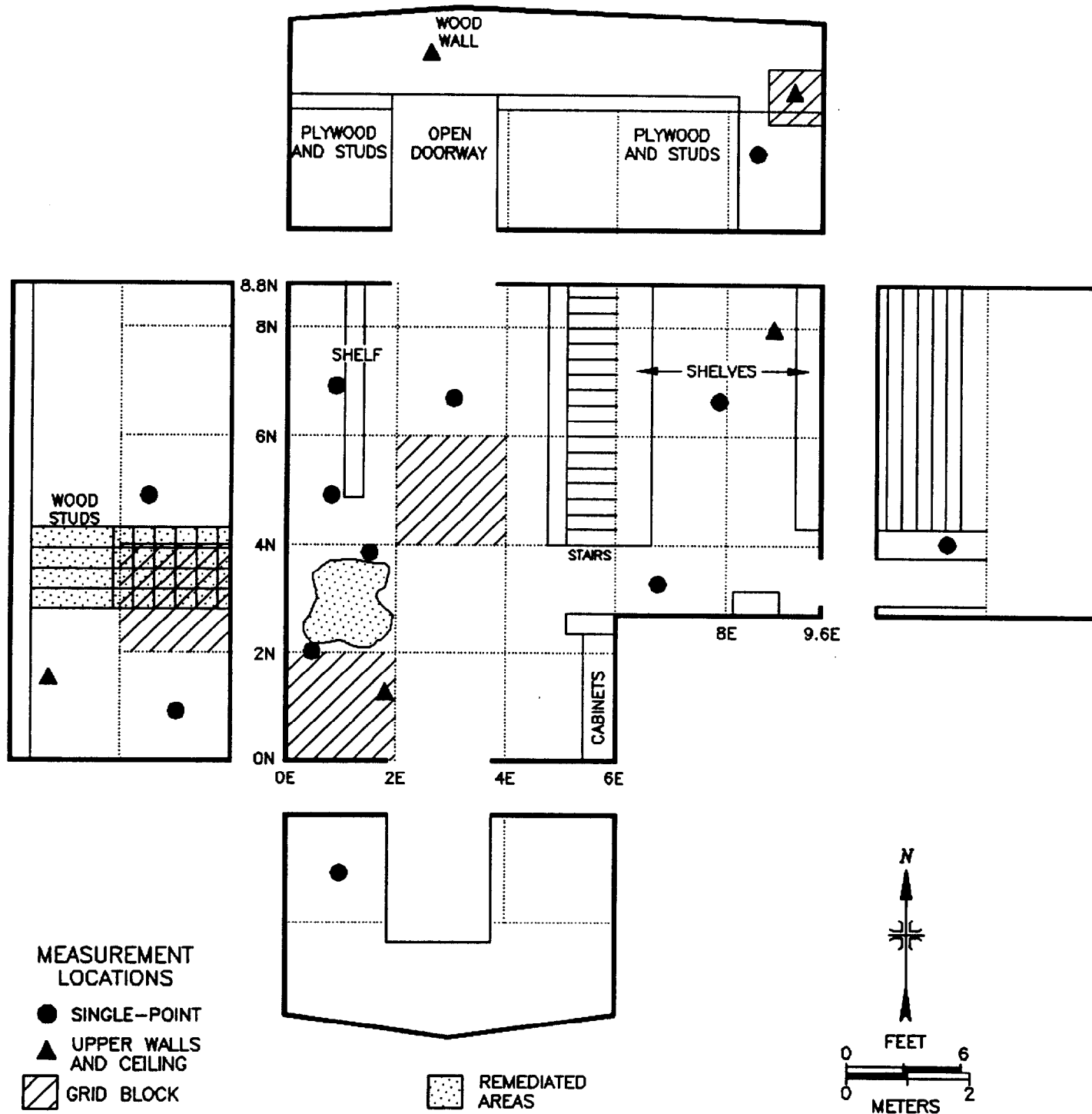
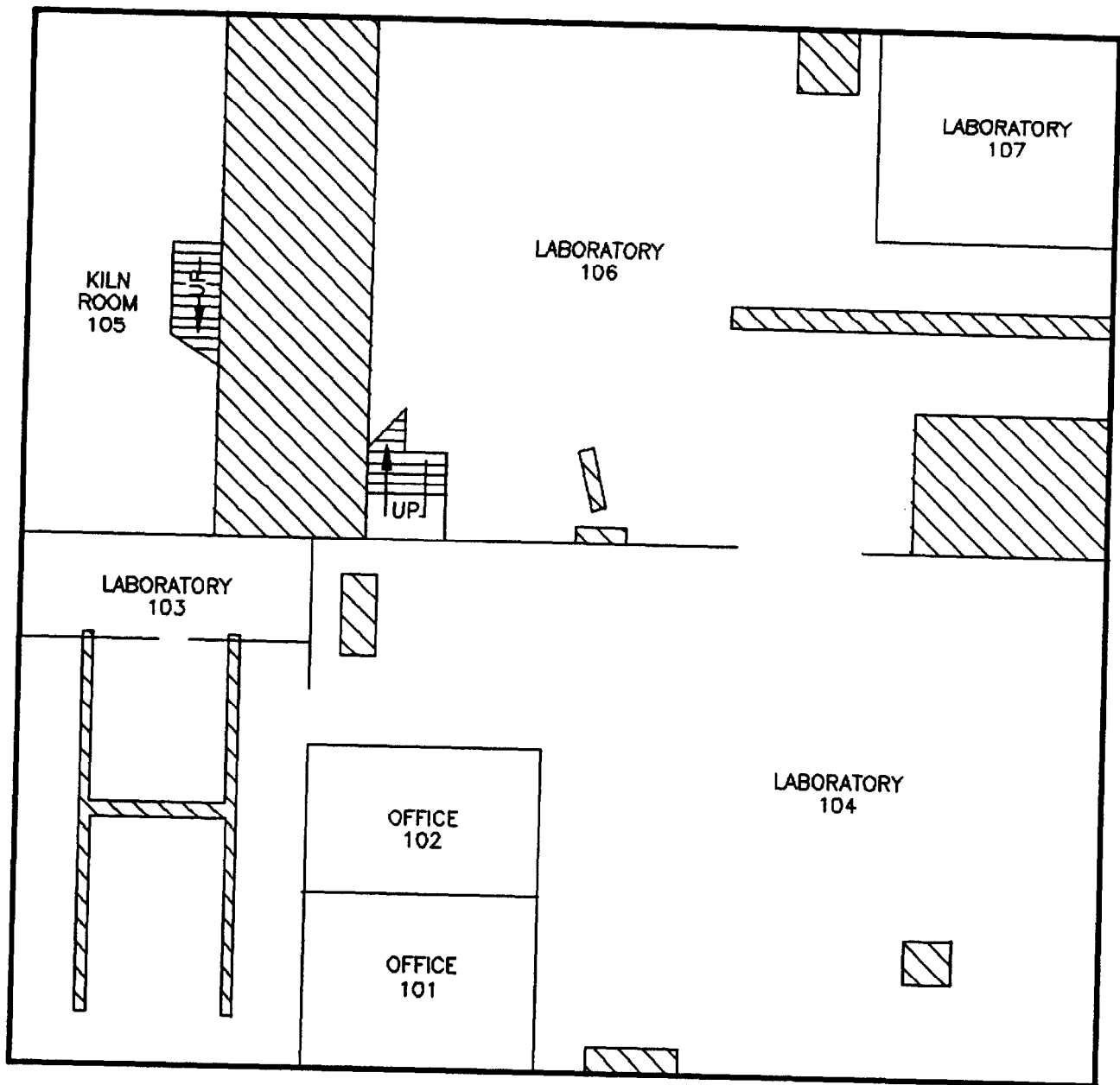


FIGURE 82: Building 23, Second Floor Storage Area – Measurement Locations



 CONTAMINATED AREA

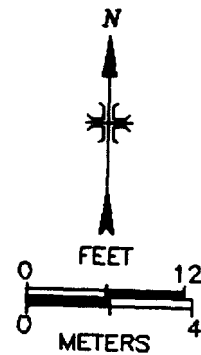


FIGURE 83: Plot Plan of Building 24

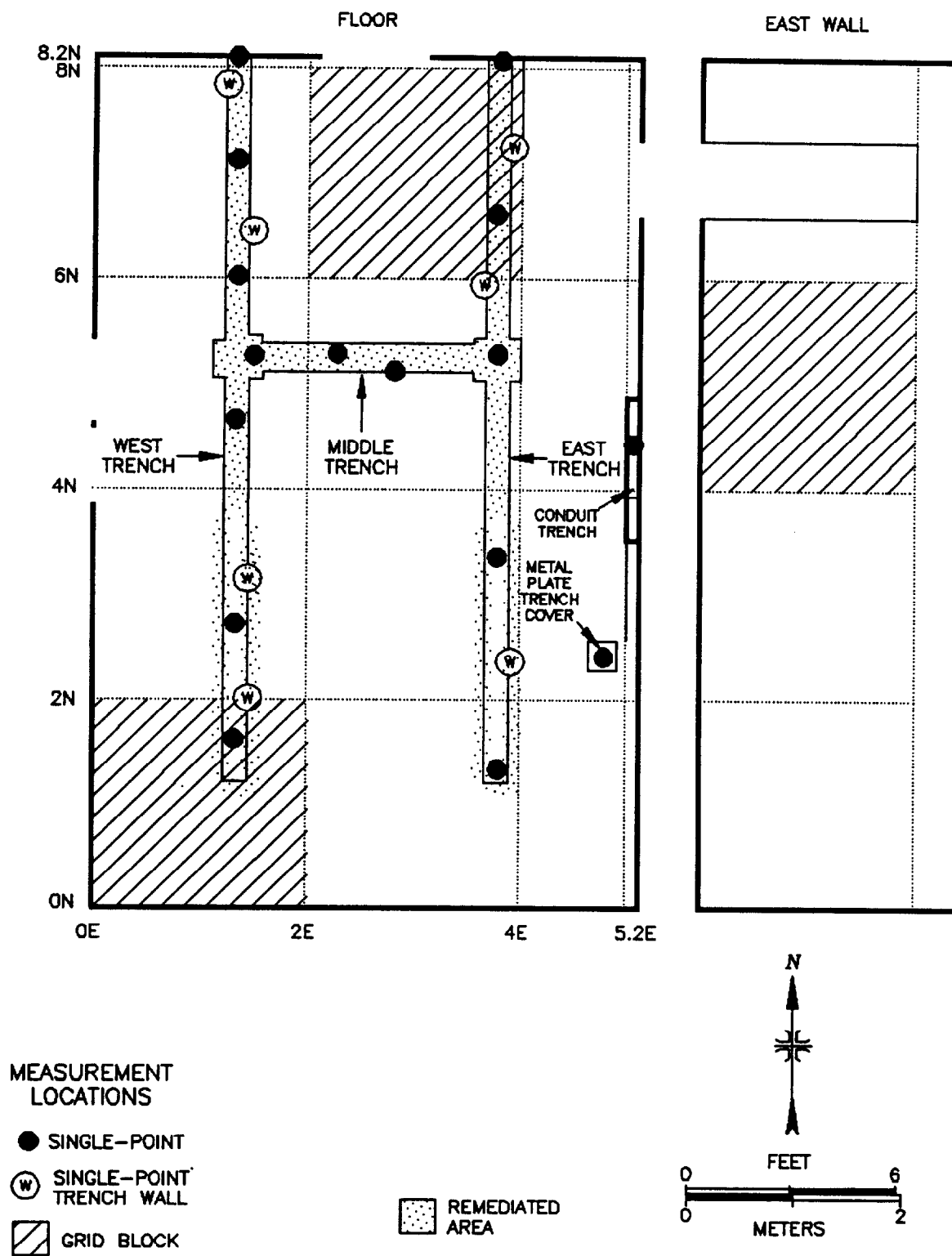


FIGURE 84: Building 24, Room 103, Floor and East Wall – Remediated Areas and Measurement Locations

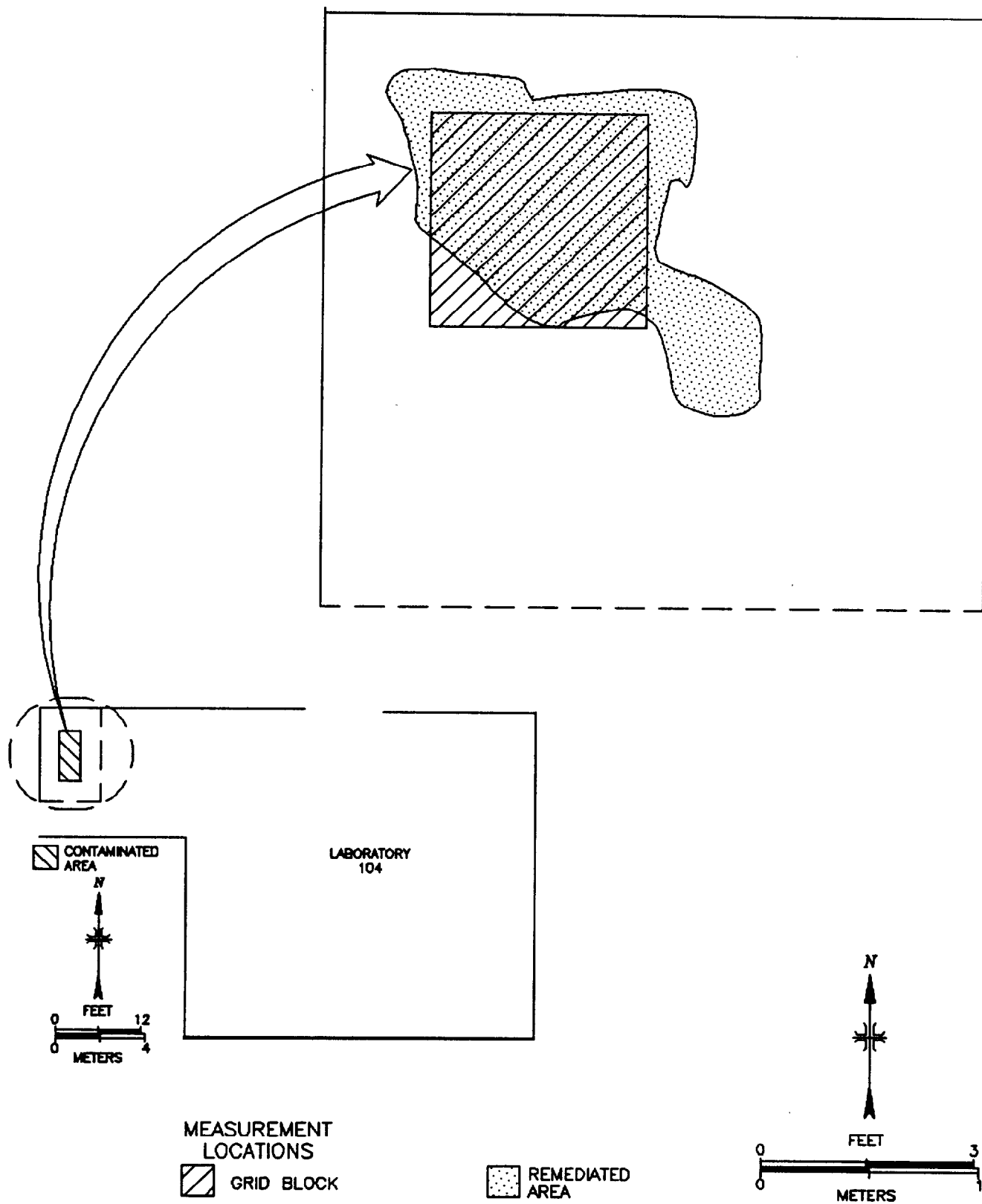


FIGURE 85: Building 24, Room 104 Northwest Corner of the Floor – Remediated Area and Measurement Locations

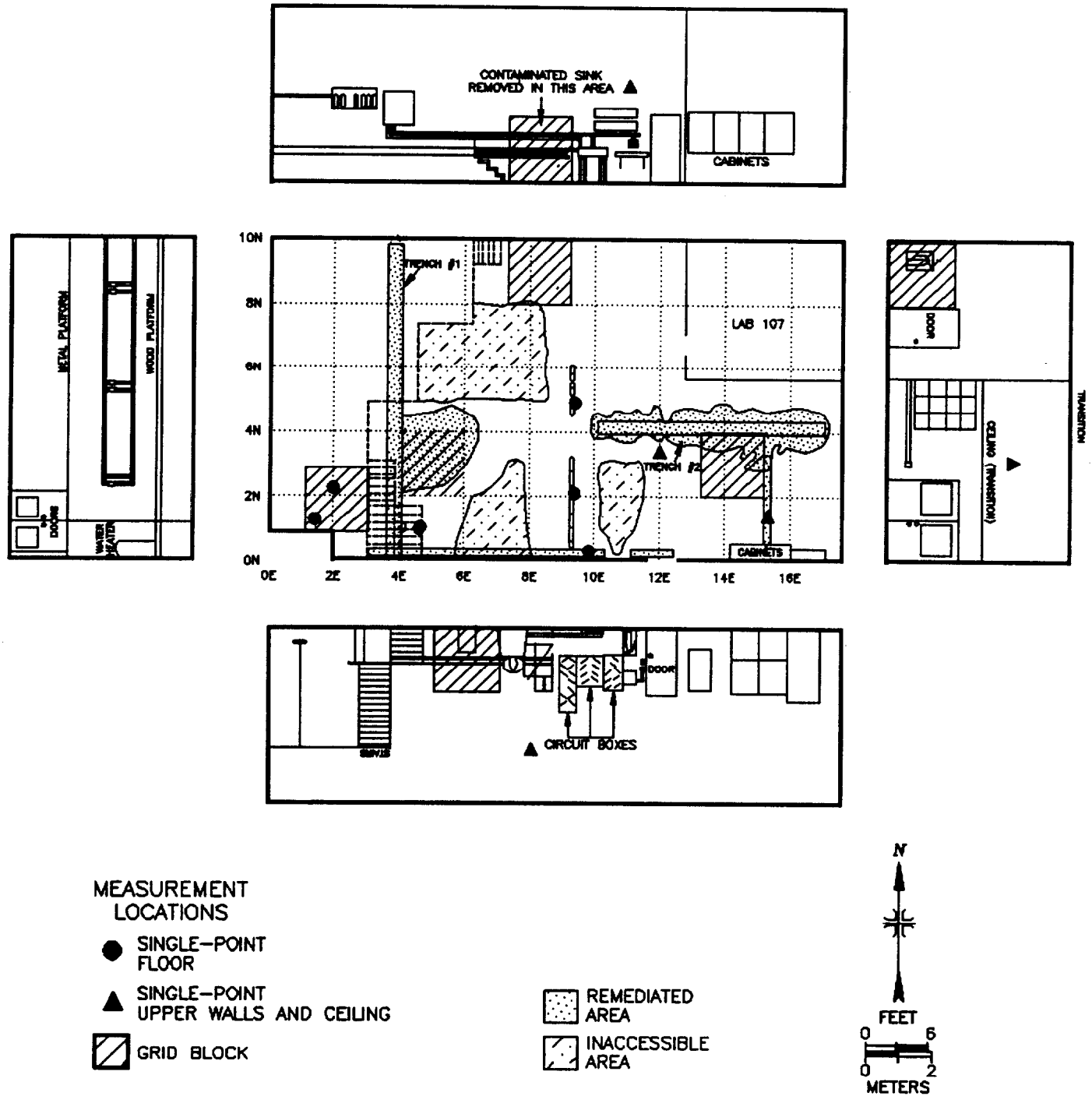


FIGURE 86: Building 24, Room 106 – Remediated Areas and Measurement Locations

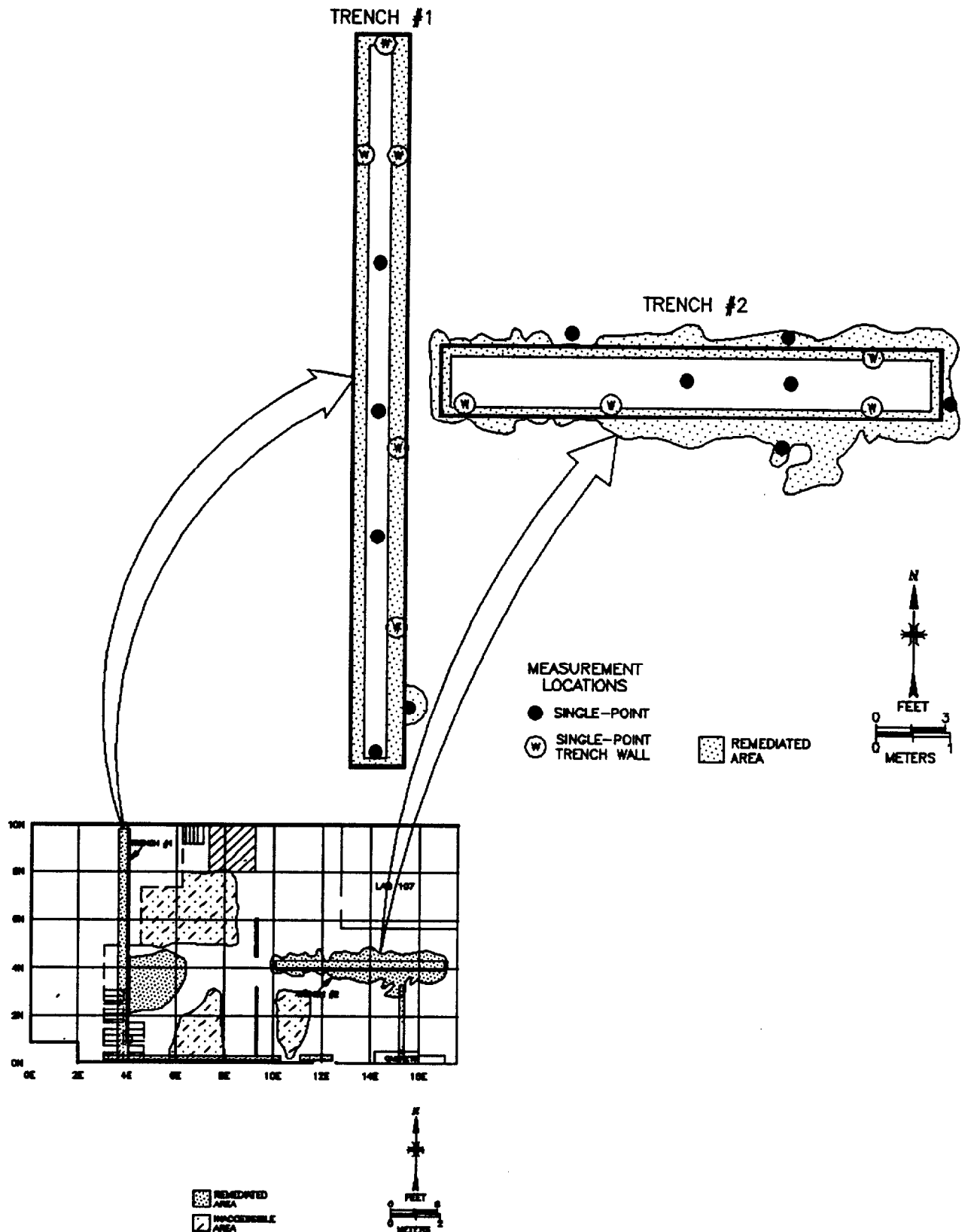


FIGURE 87: Building 24, Room 106 Trenches #1 and 2 – Remediated Areas and Measurement Locations

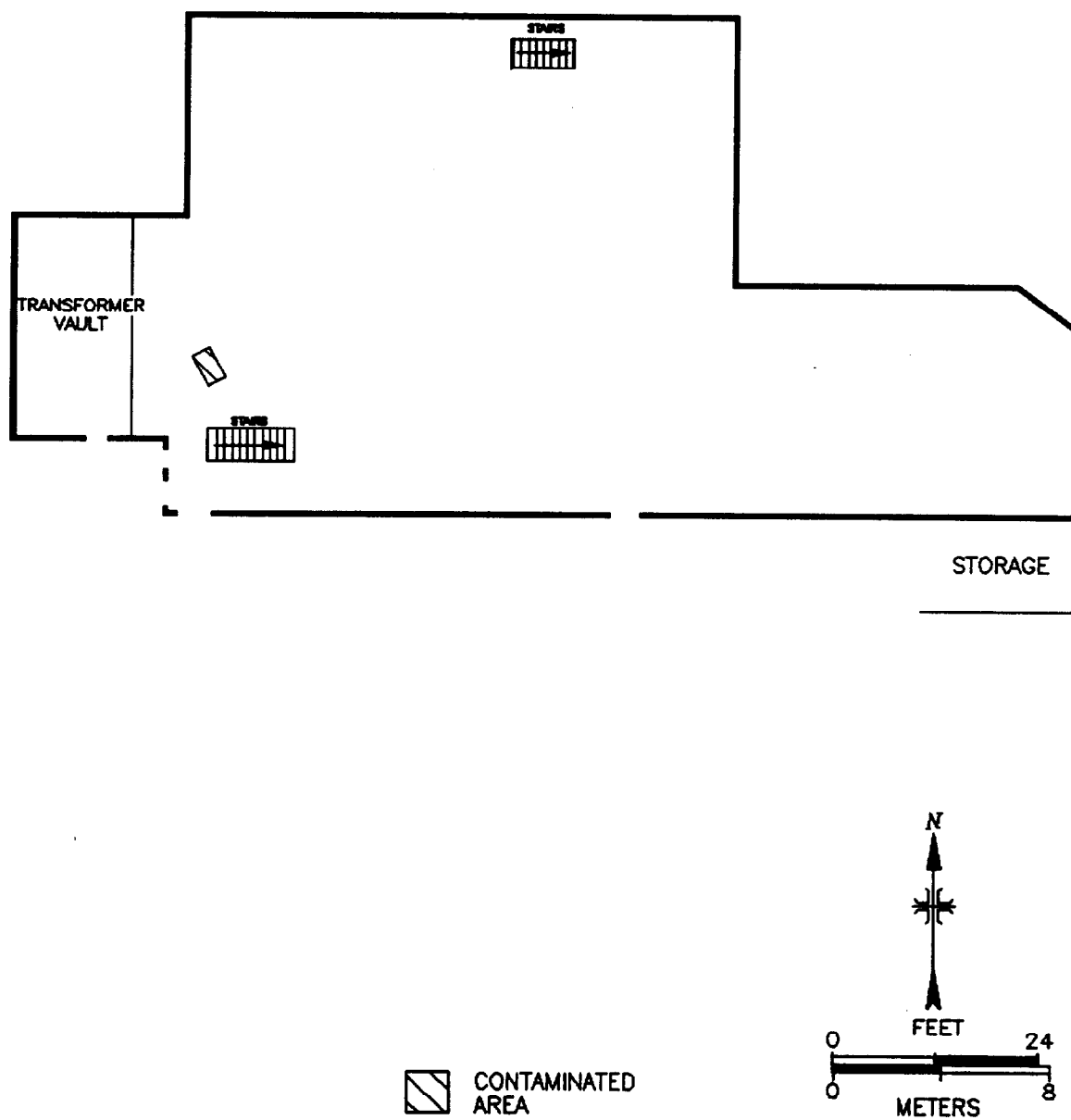


FIGURE 88: Plot Plan of Building 25, First Floor

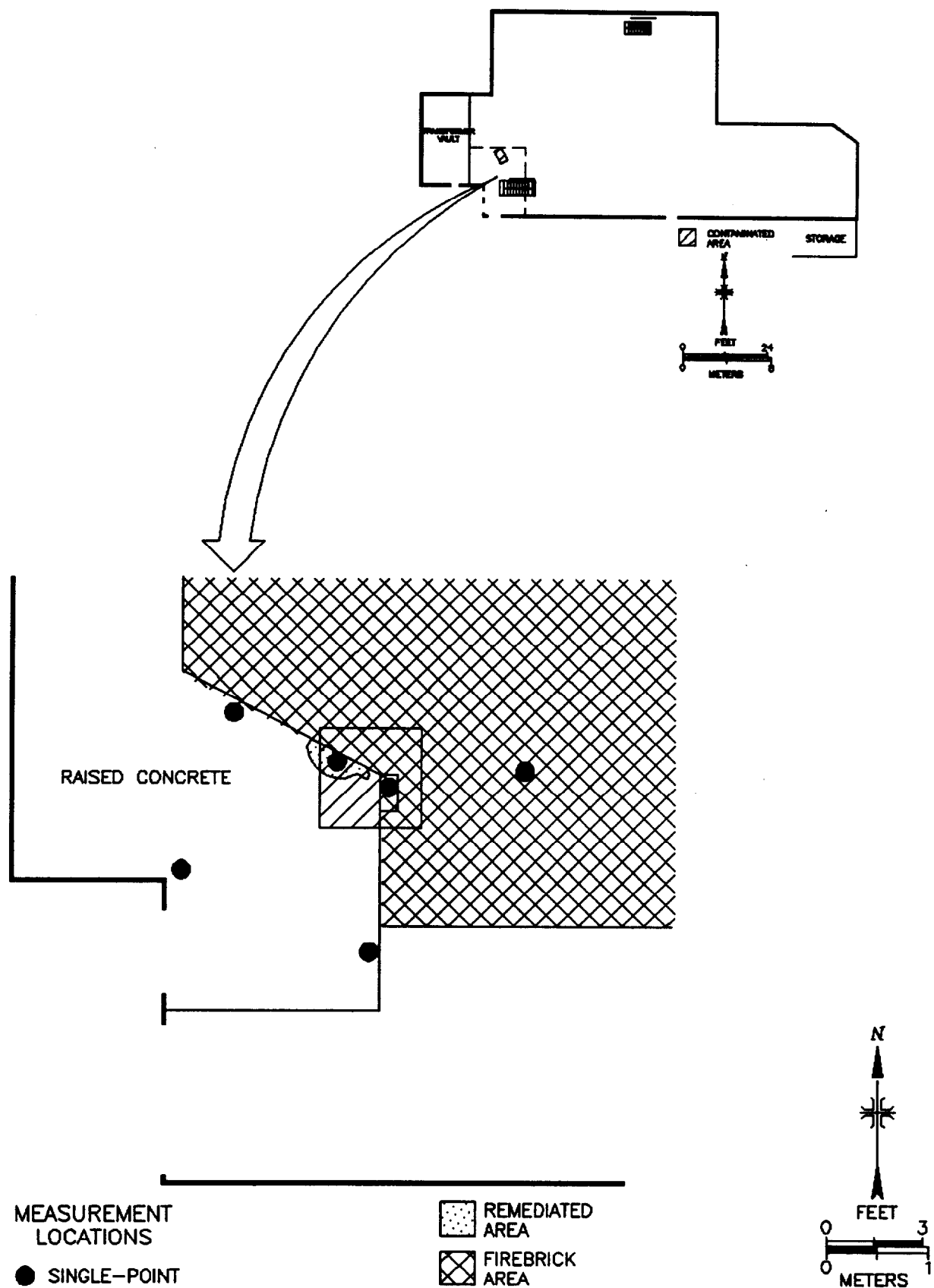


FIGURE 89: Building 25, First Floor, Southwest Corner — Remediated Area and Measurement Locations

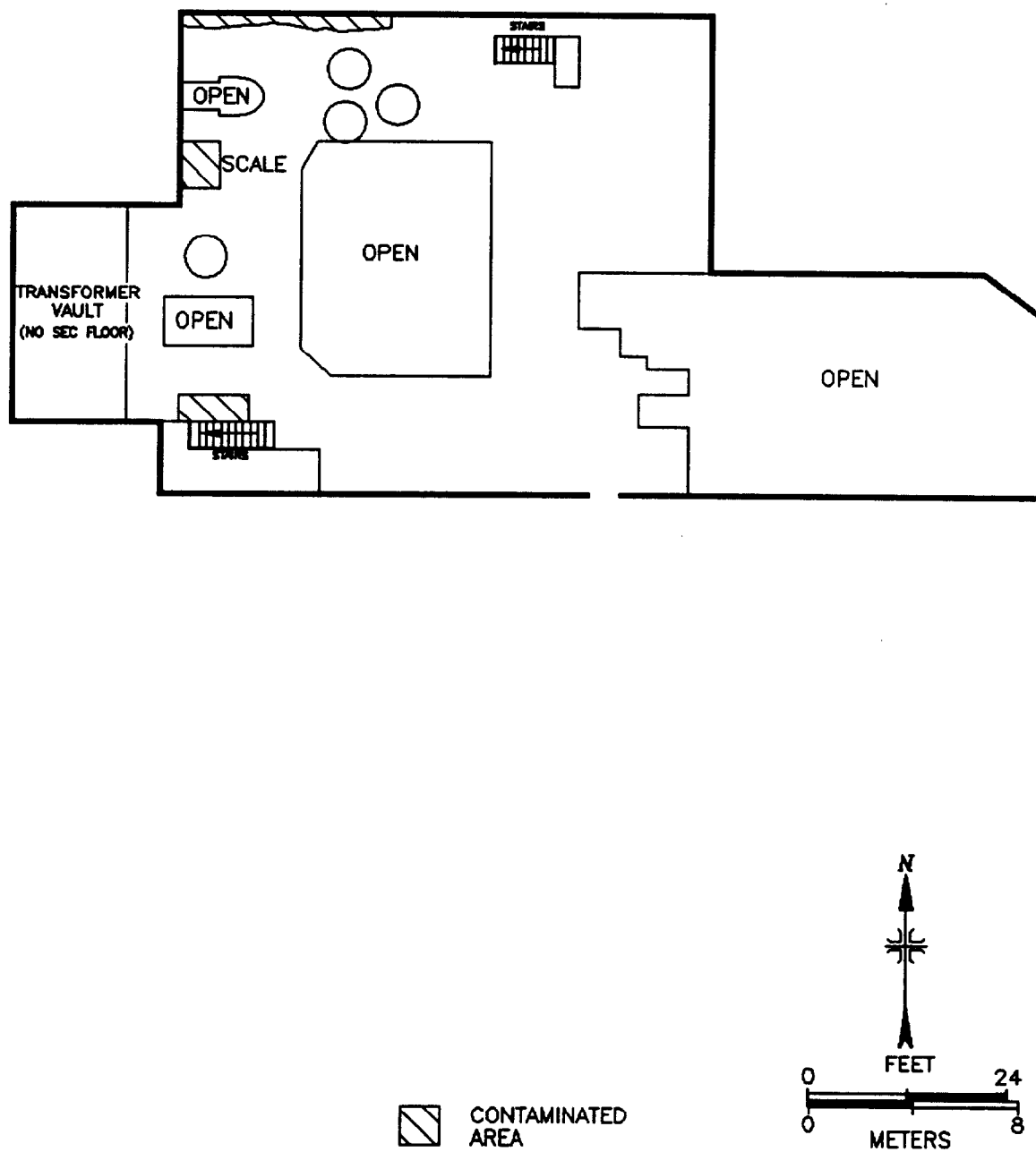


FIGURE 90: Plot Plan of Building 25, Mezzanine

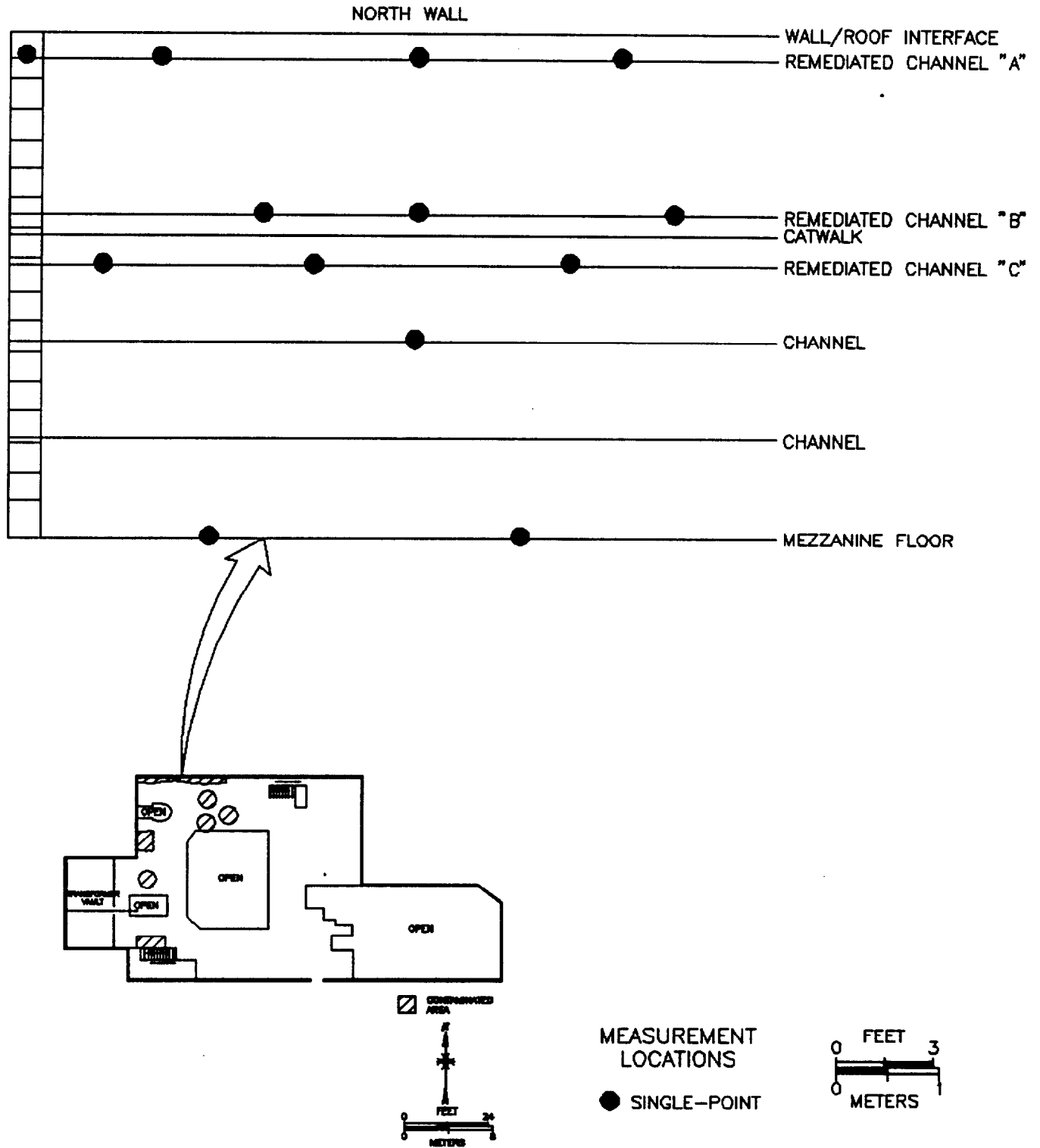
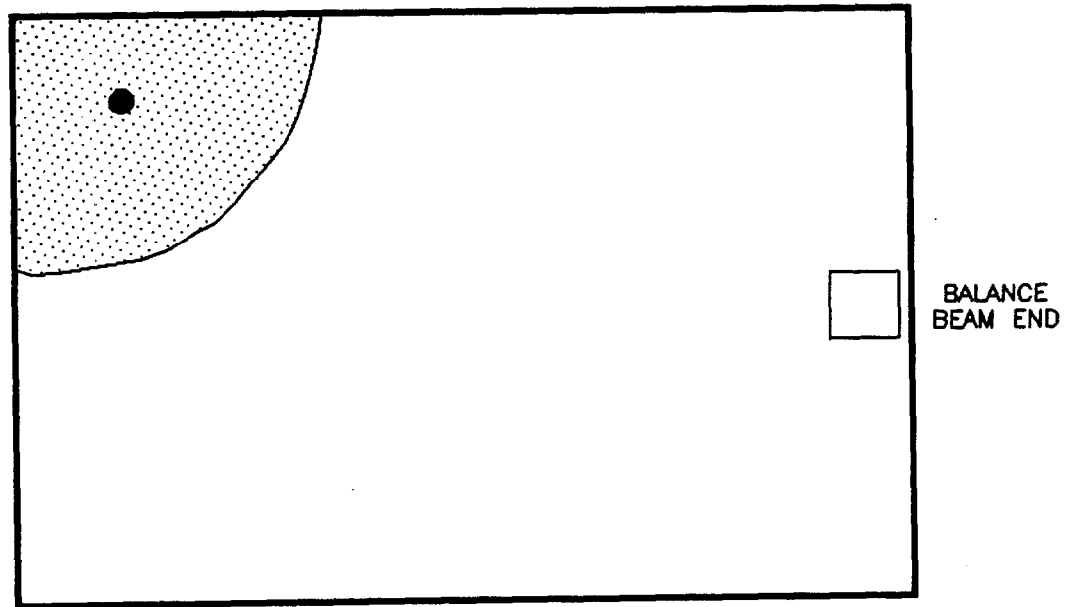


FIGURE 91: Building 25, Mezzanine, Northwest Corner of the North Wall – Measurement Locations



MEASUREMENT
LOCATIONS

● SINGLE-POINT

 REMEDIATED
AREA

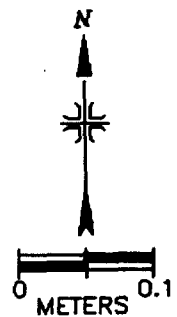
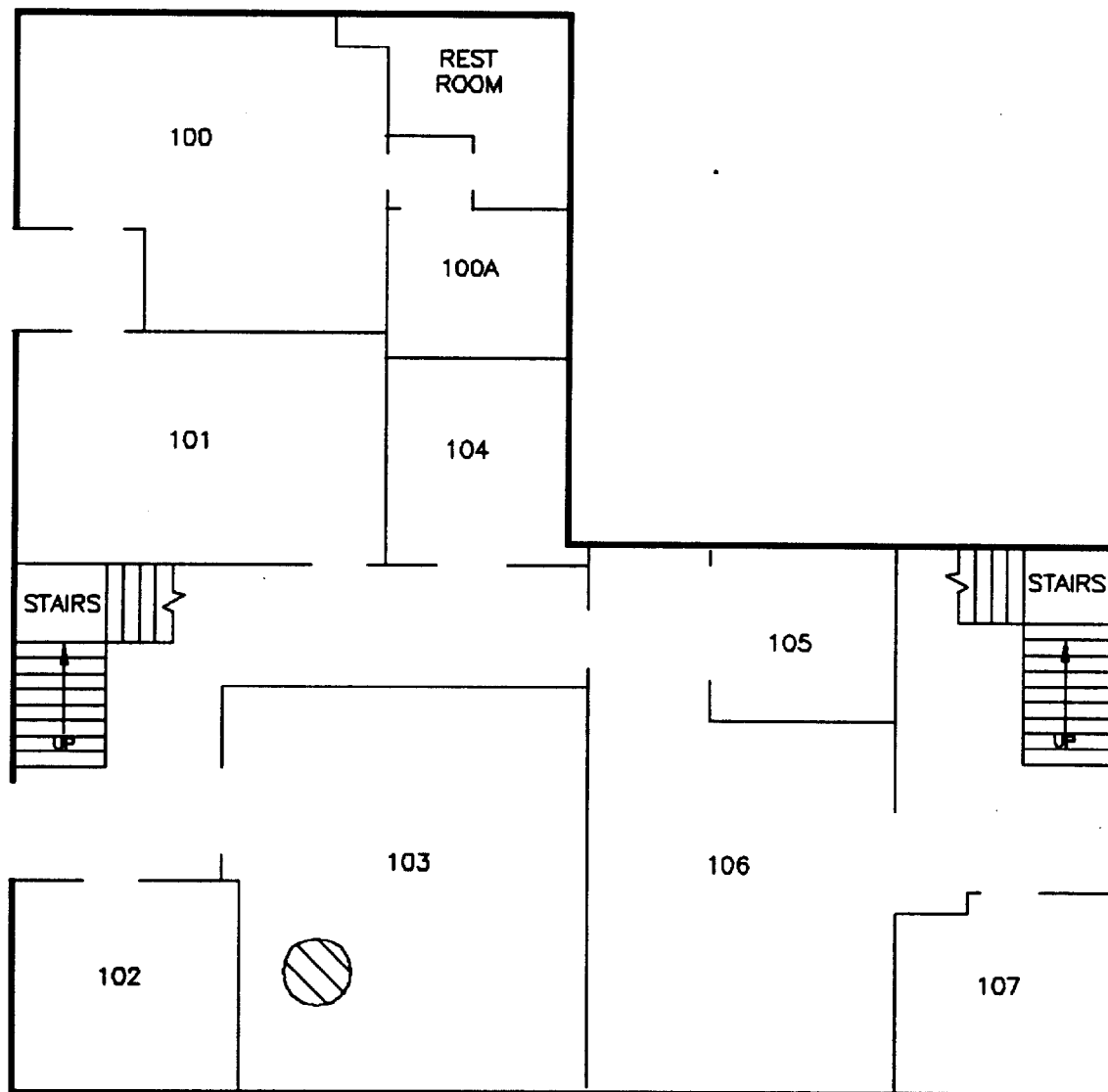


FIGURE 92: Building 25, Scale Platform Located on the Mezzanine –
Remediated Area and Measurement Locations



 CONTAMINATED AREA

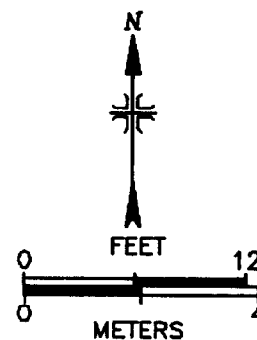


FIGURE 93: Plot Plan of Building 26, First Floor

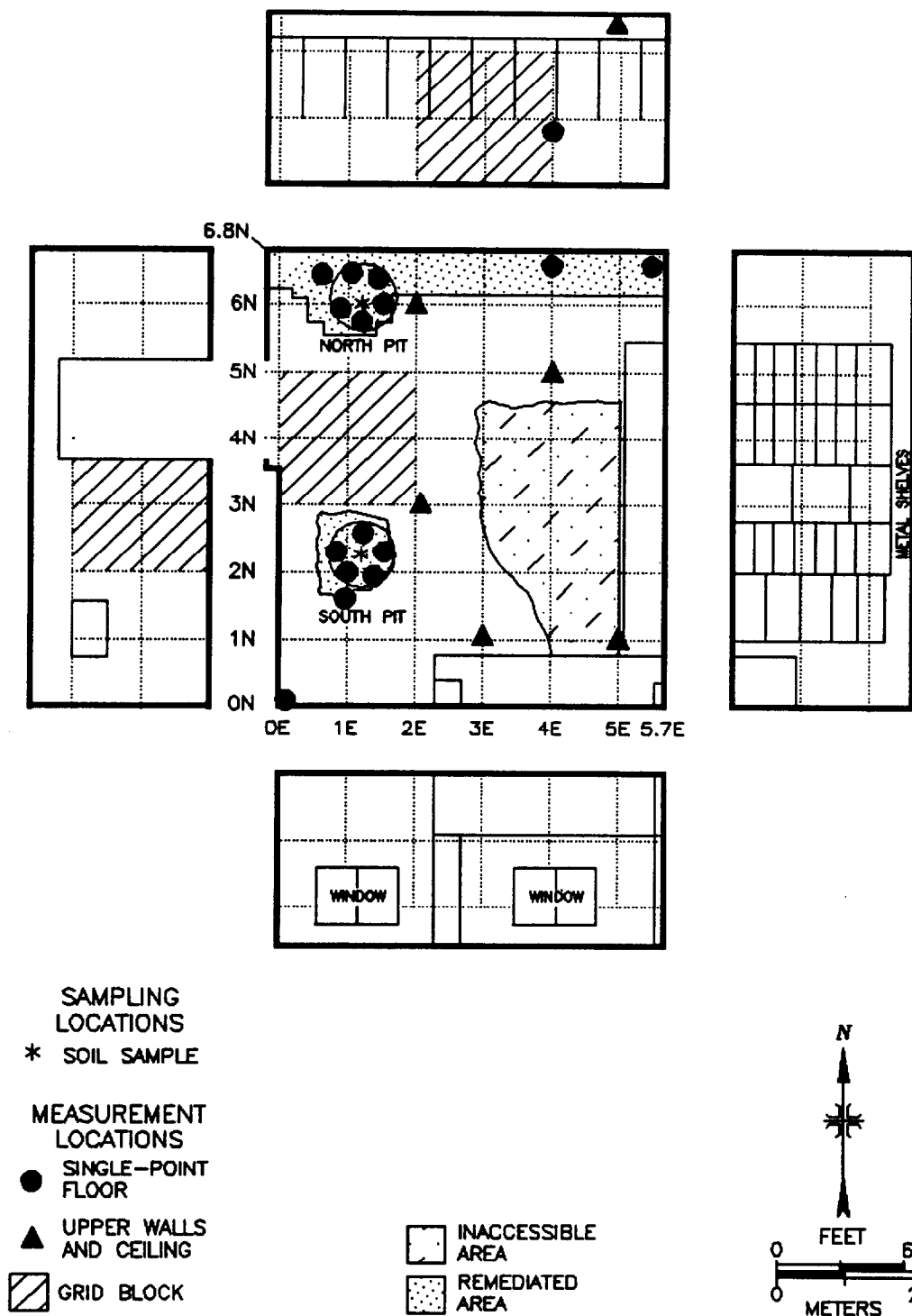


FIGURE 94: Building 26, Room 103 – Remediated Areas and Measurement and Sampling Locations

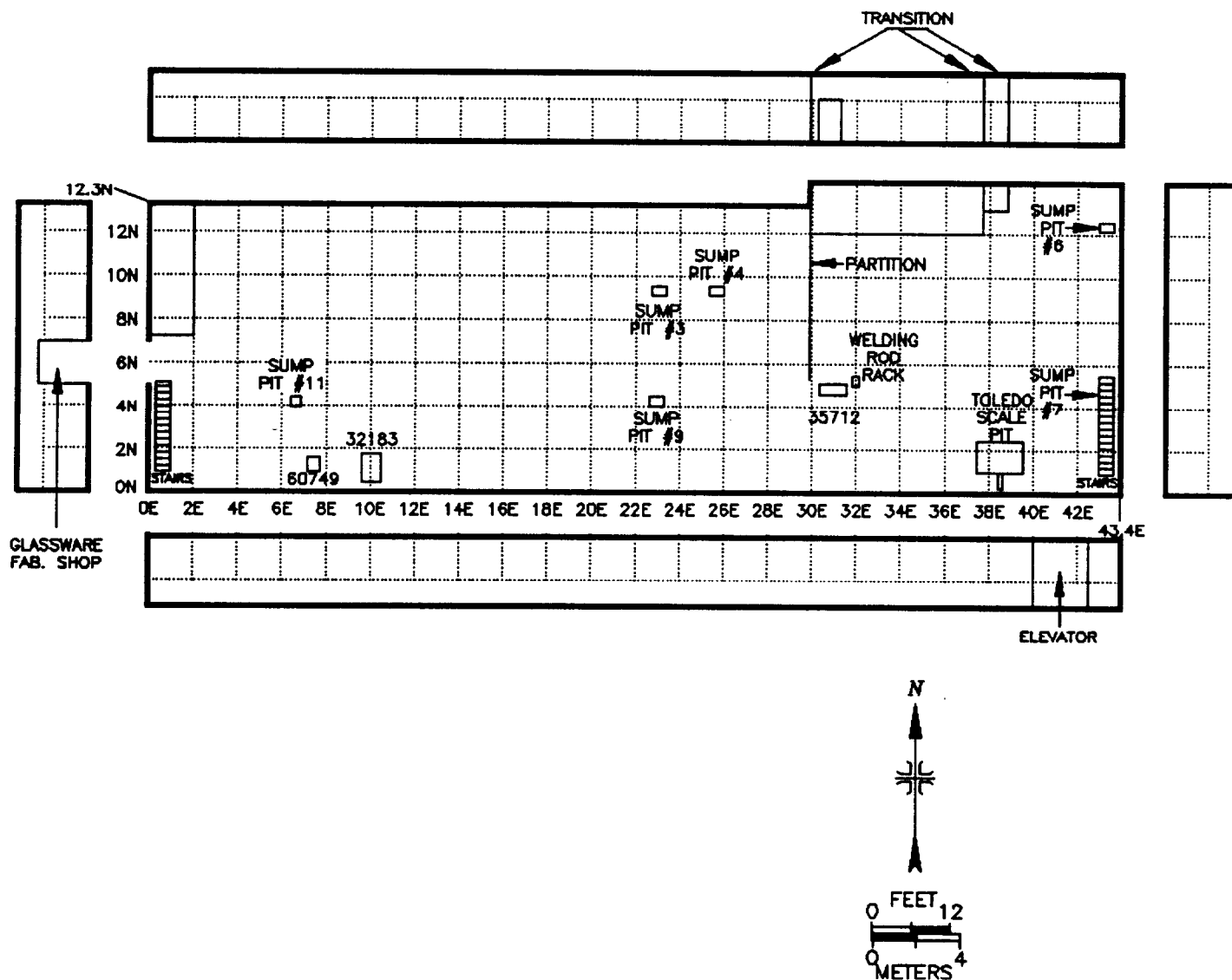


FIGURE 95: Building 28, Basement Plot Plan – Reference Grid and Sump Locations

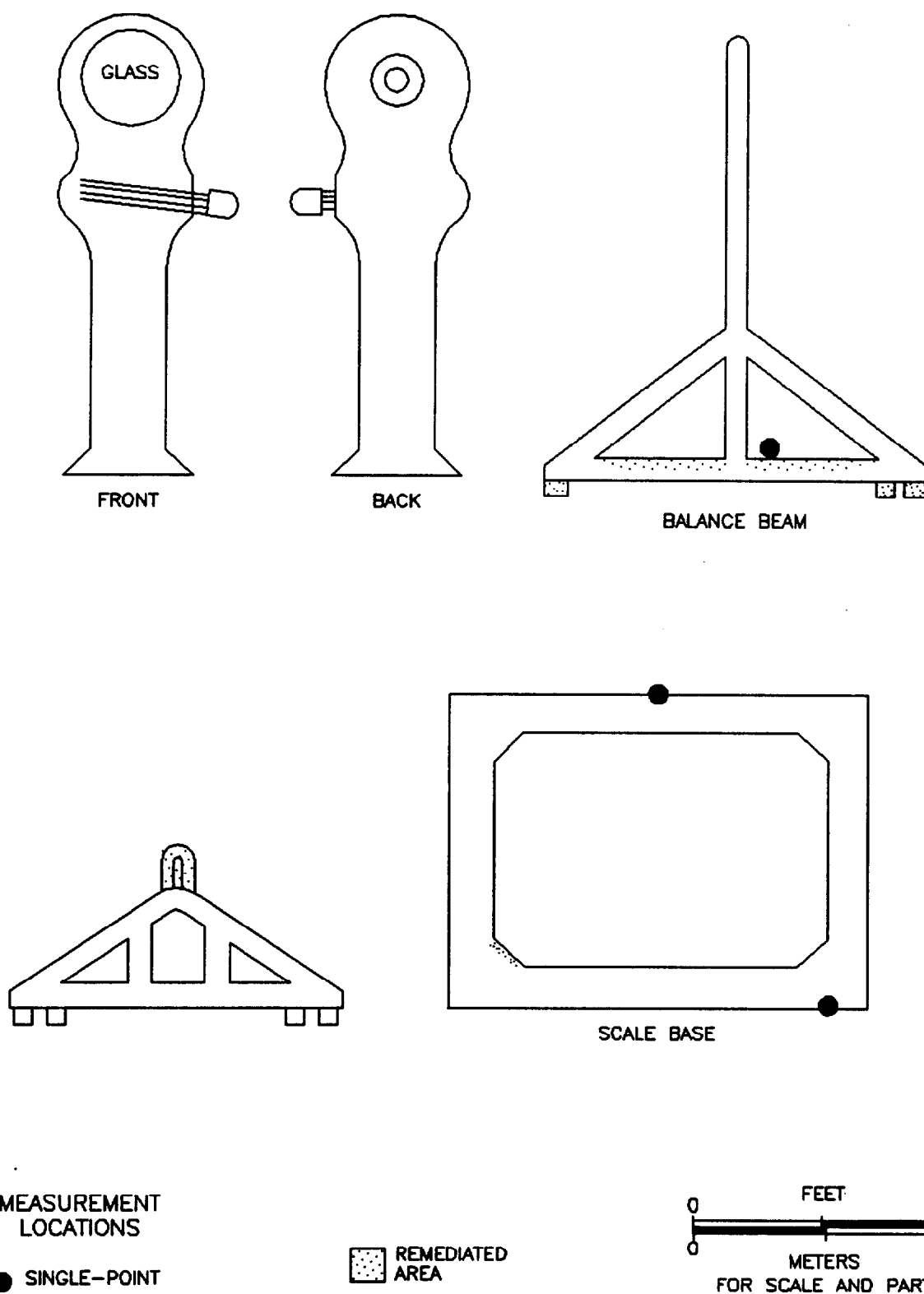


FIGURE 96: Building 28, Basement, Toledo Scale #31155 (Disassembled) – Remediated Areas and Measurement Locations

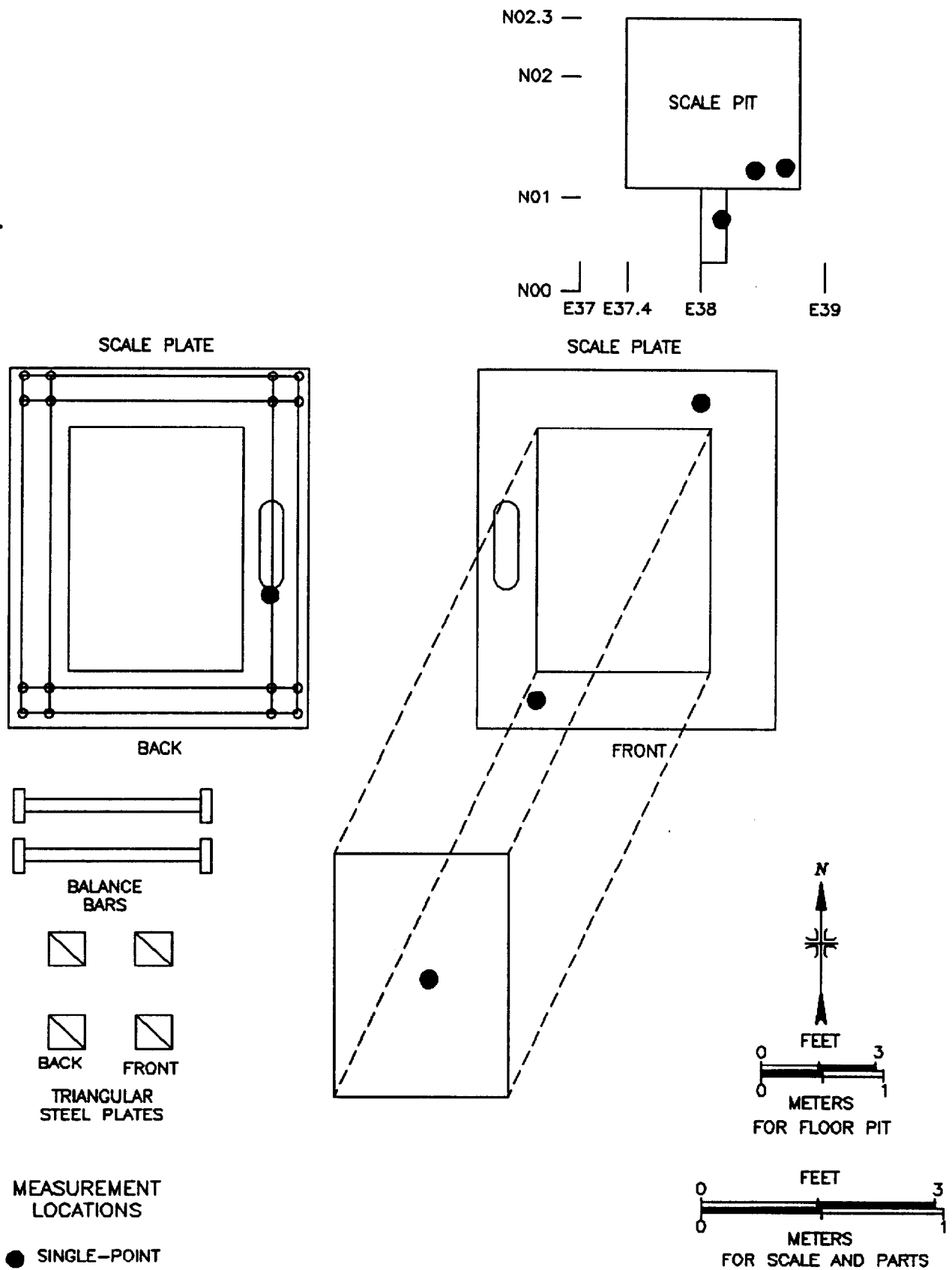
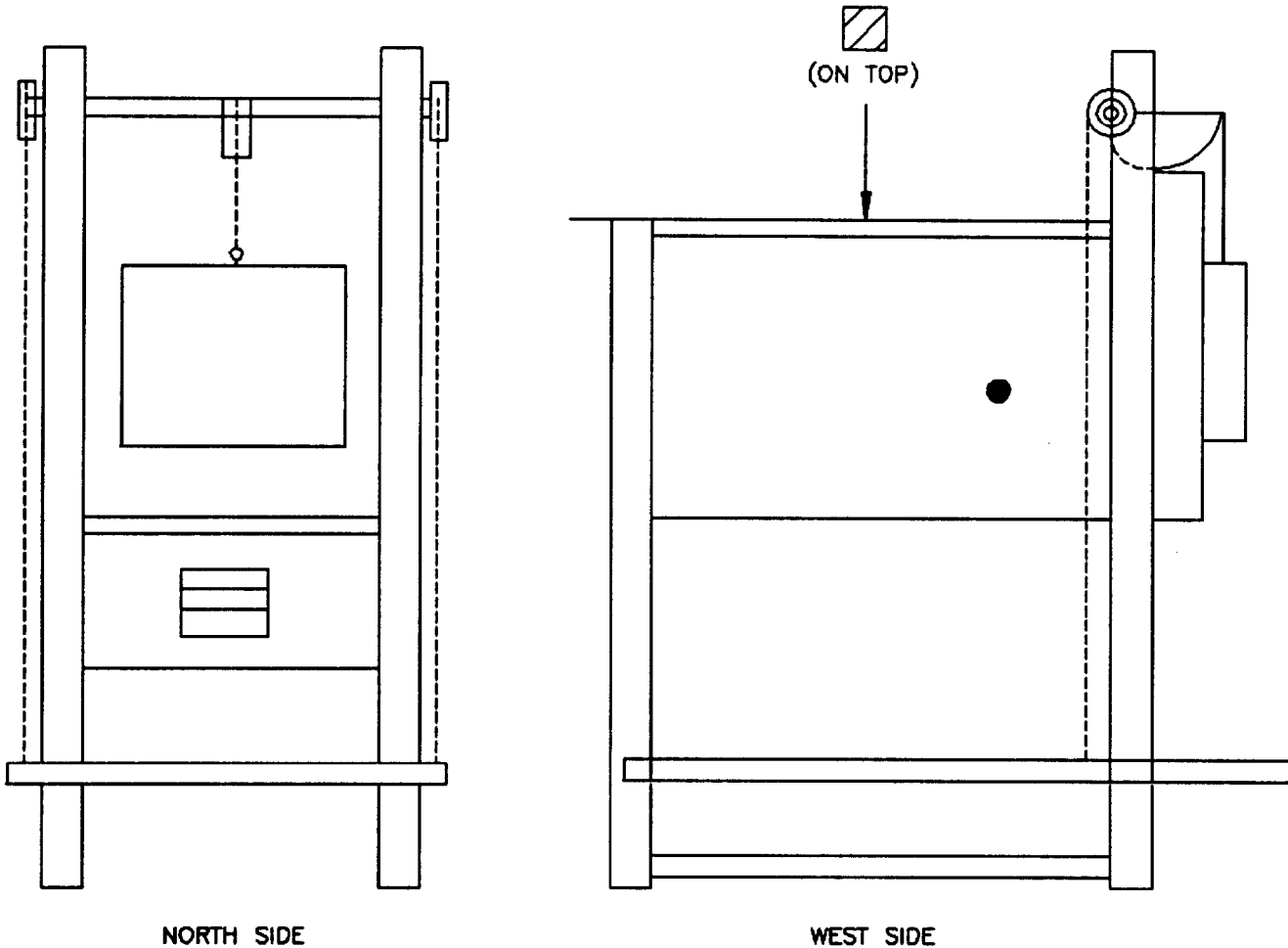


FIGURE 97: Building 28, Basement, Toledo Scale #31155 and Scale Pit – Measurement Locations



MEASUREMENT
LOCATIONS

● SINGLE-POINT

▨ GRID BLOCK

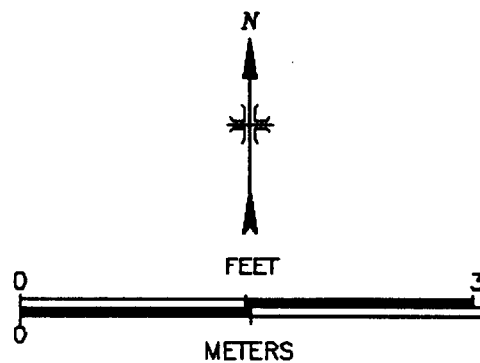


FIGURE 98: Building 28, Basement, Hoskins Furnace #32183 –
Measurement Locations

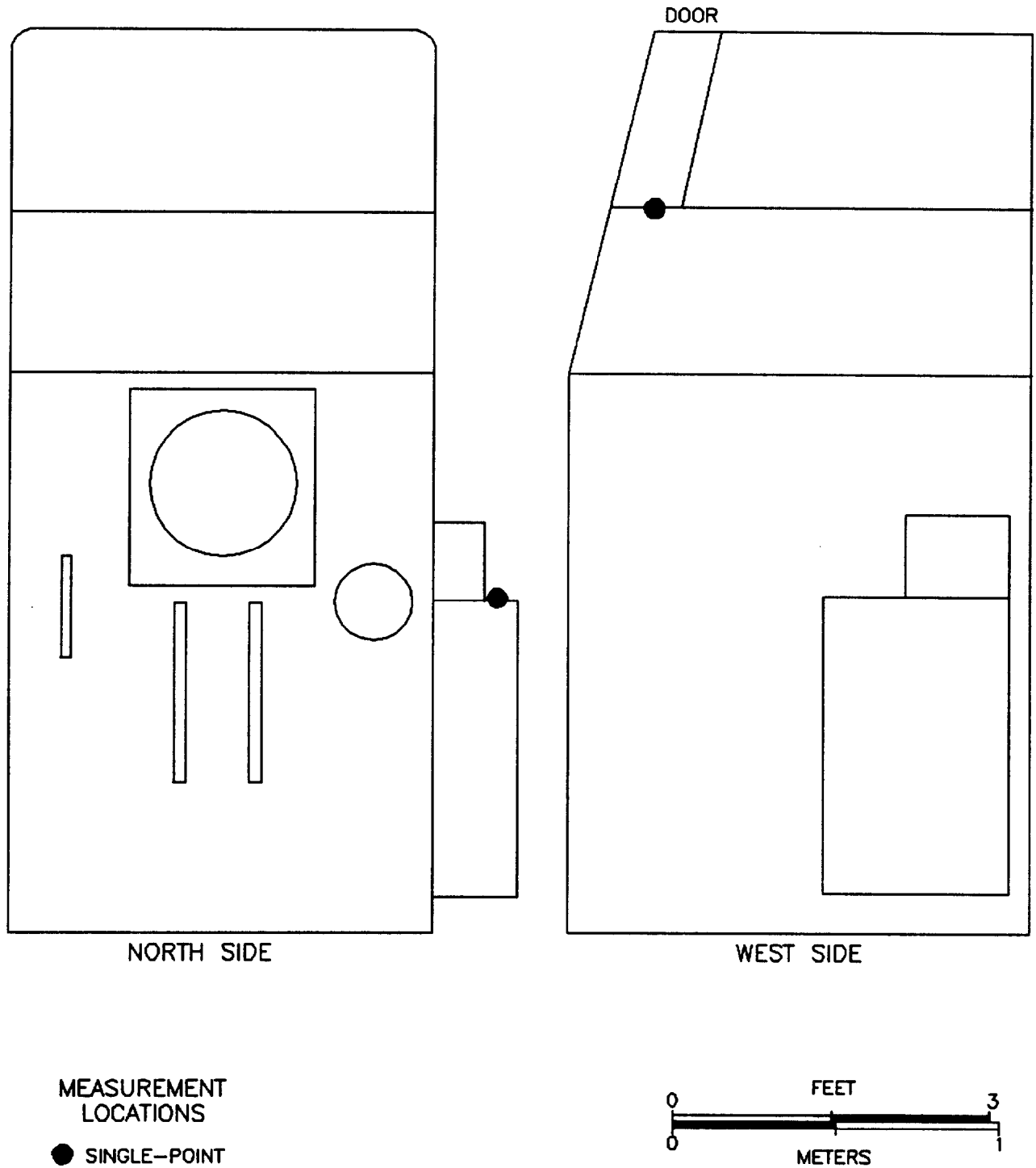
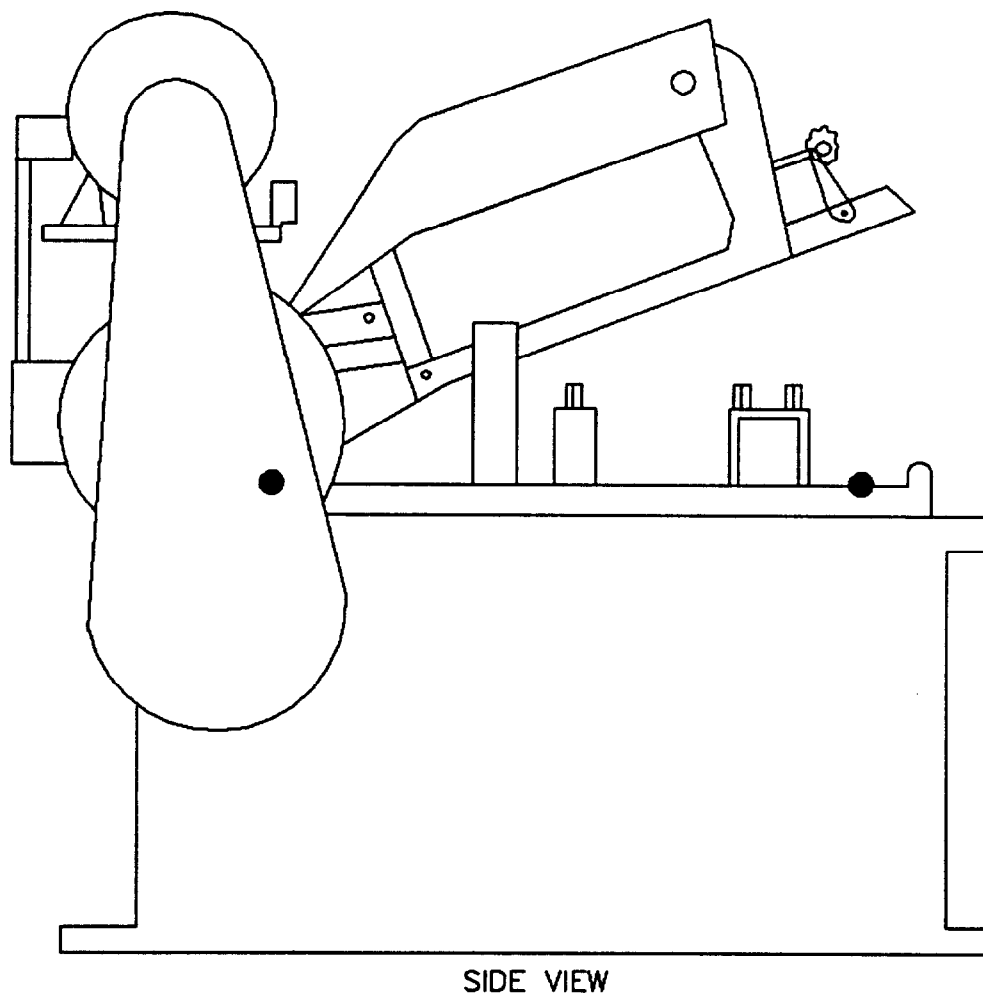


FIGURE 99: Building 28, Basement, Lindberg Furnace #60749 – Measurement Locations



MEASUREMENT
LOCATIONS

● SINGLE-POINT

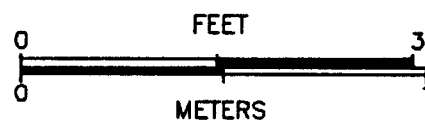
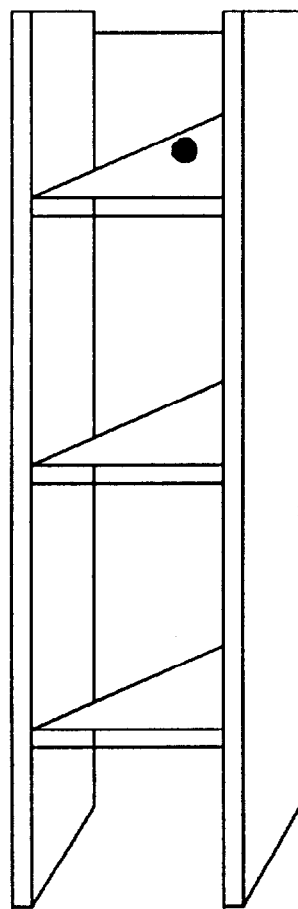
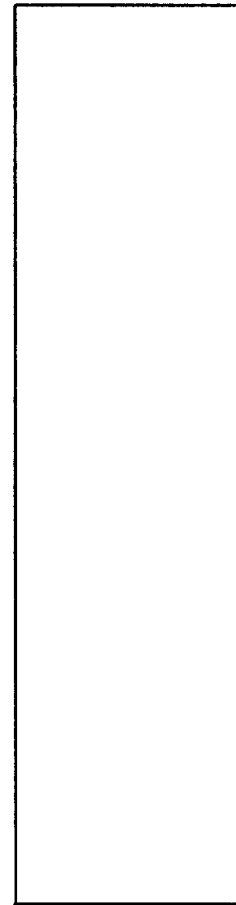


FIGURE 100: Building 28, Basement, Hacksaw #35712 –
Measurement Locations



FRONT



BACK

MEASUREMENT
LOCATIONS

● SINGLE-POINT

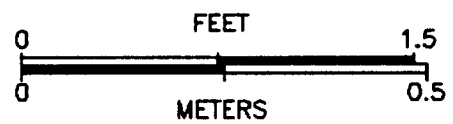


FIGURE 101: Building 28, Basement, Welding Rod Rack –
Measurement Locations

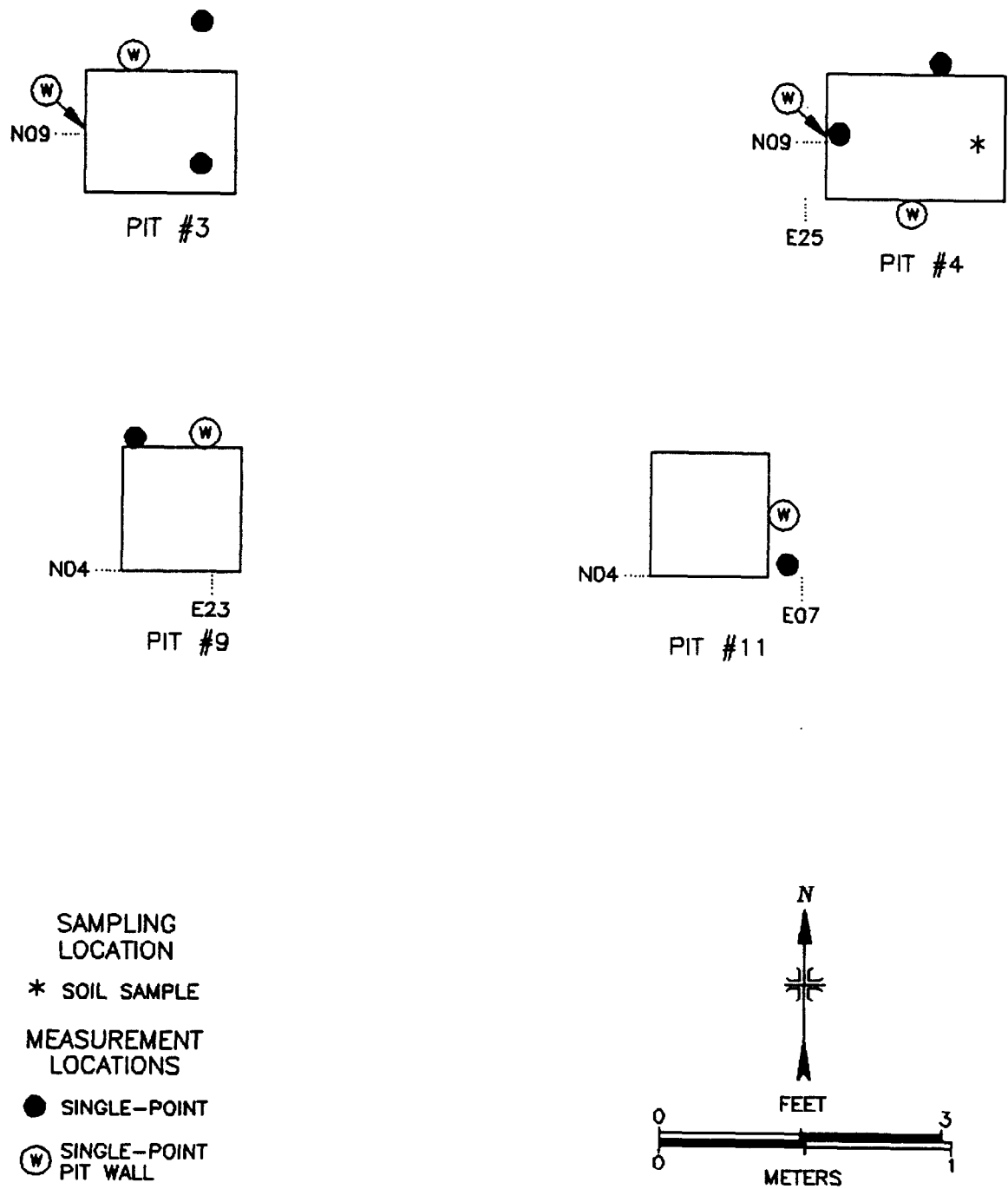


FIGURE 102: Building 28, Basement, Pits #3, 4, 9 and 11 – Measurement and Sampling Locations

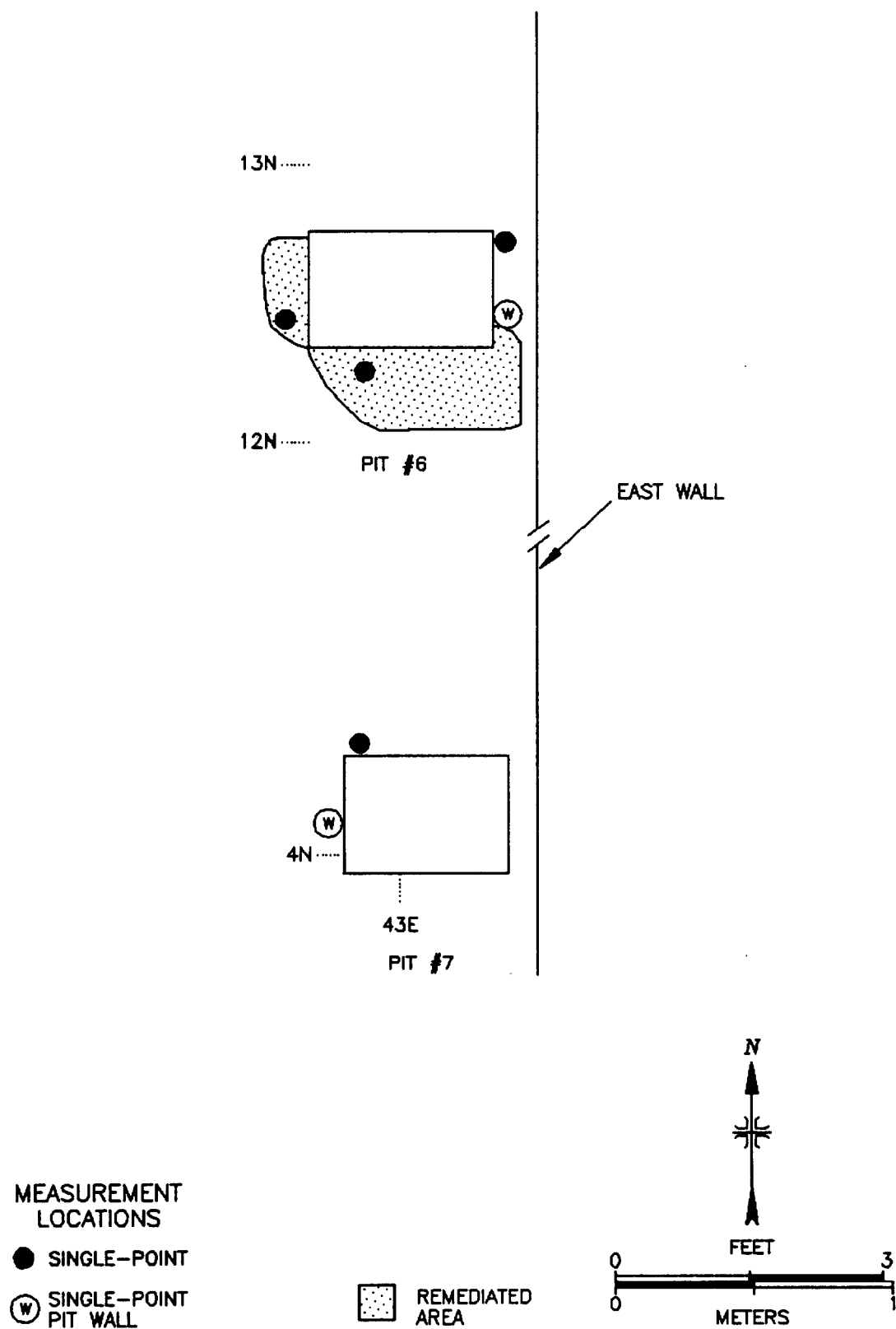


FIGURE 103: Building 28, Basement Pit, #6 and 7 - Measurement Locations

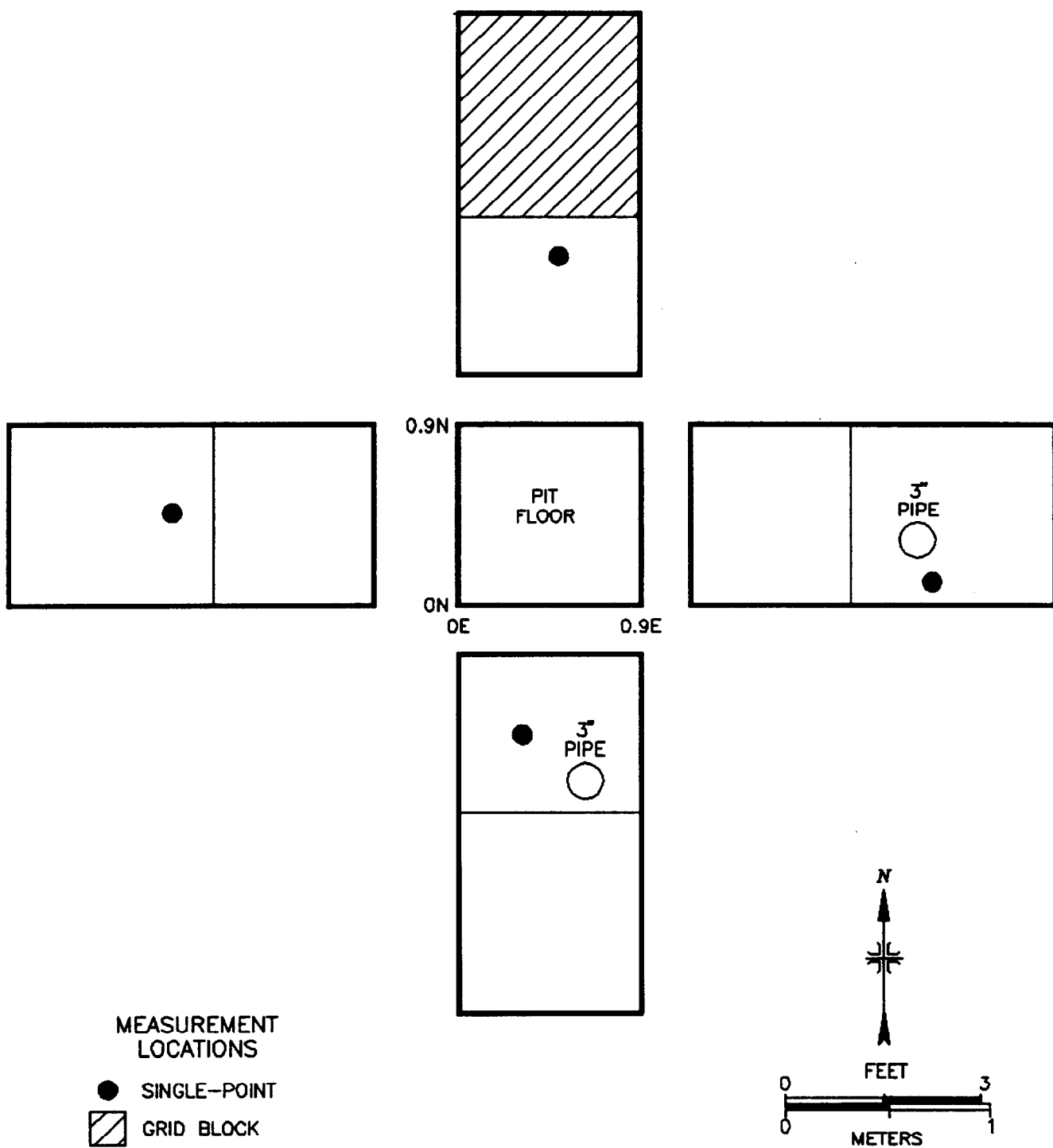


FIGURE 104: Building 28, Basement, Pit #12 – Measurement Locations

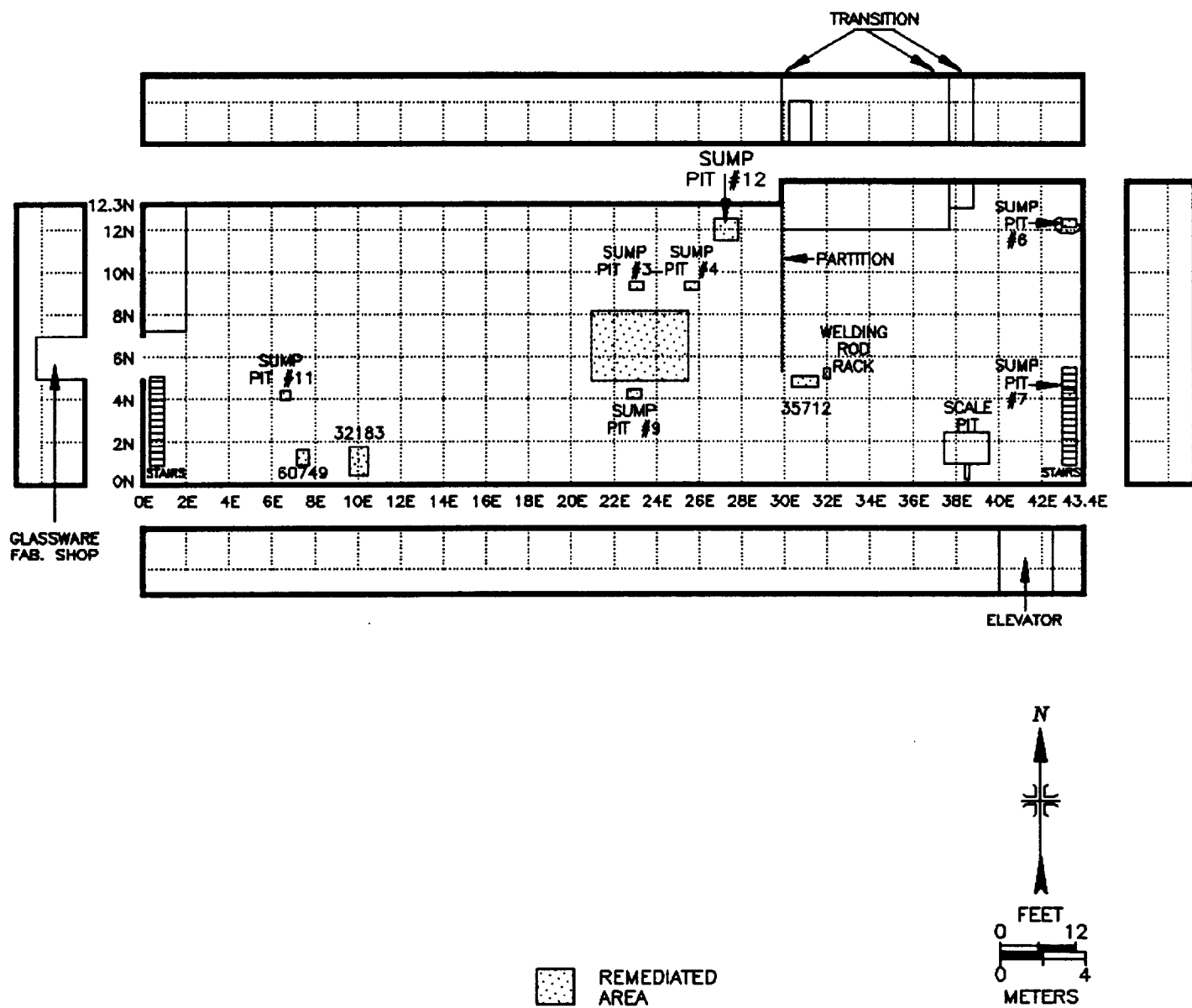


FIGURE 105: Building 28, Basement – Remediated Areas on Floor

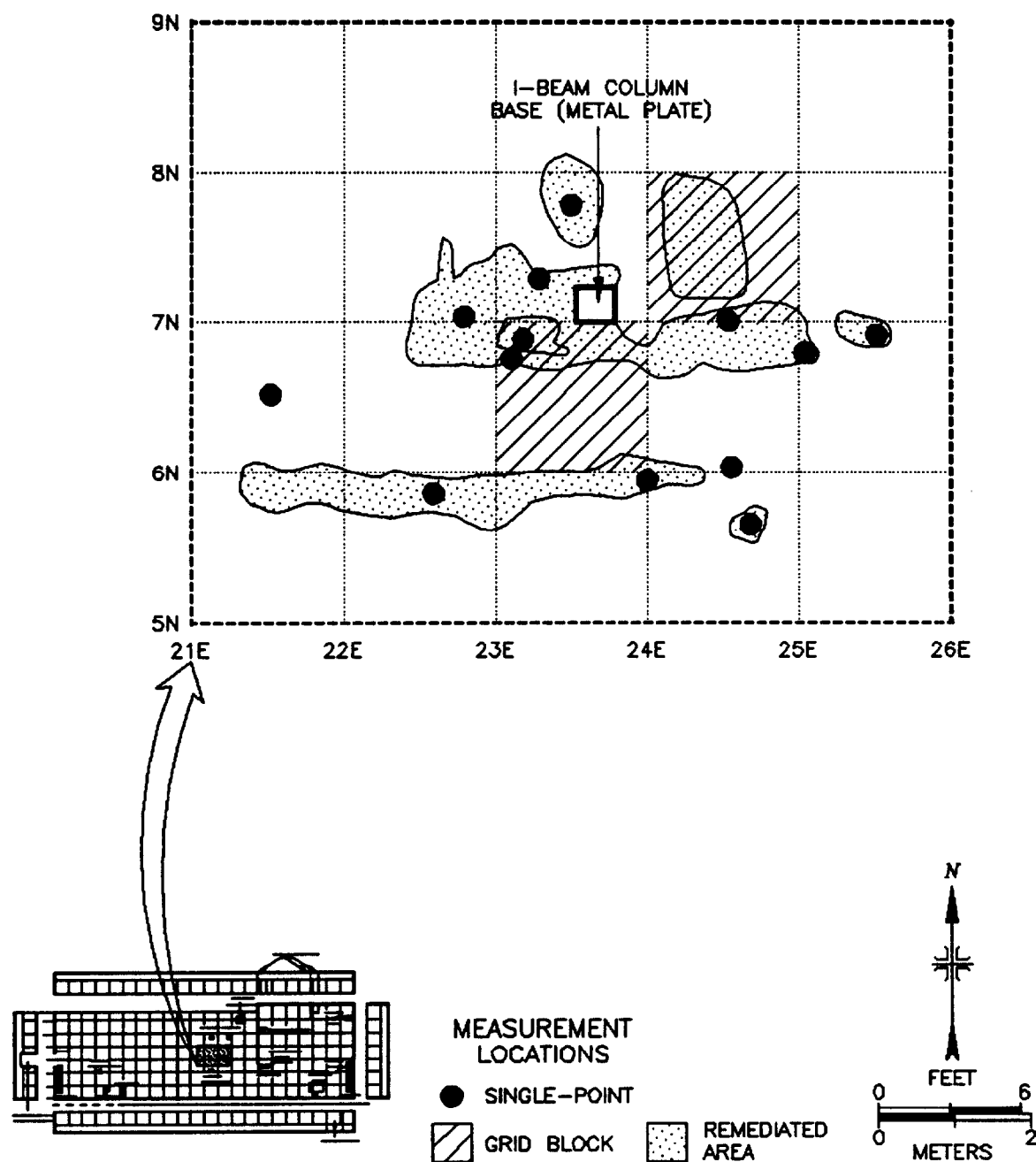


FIGURE 106: Building 28, Basement, Breakout of Remediated Floor Area – Measurement and Sampling Locations

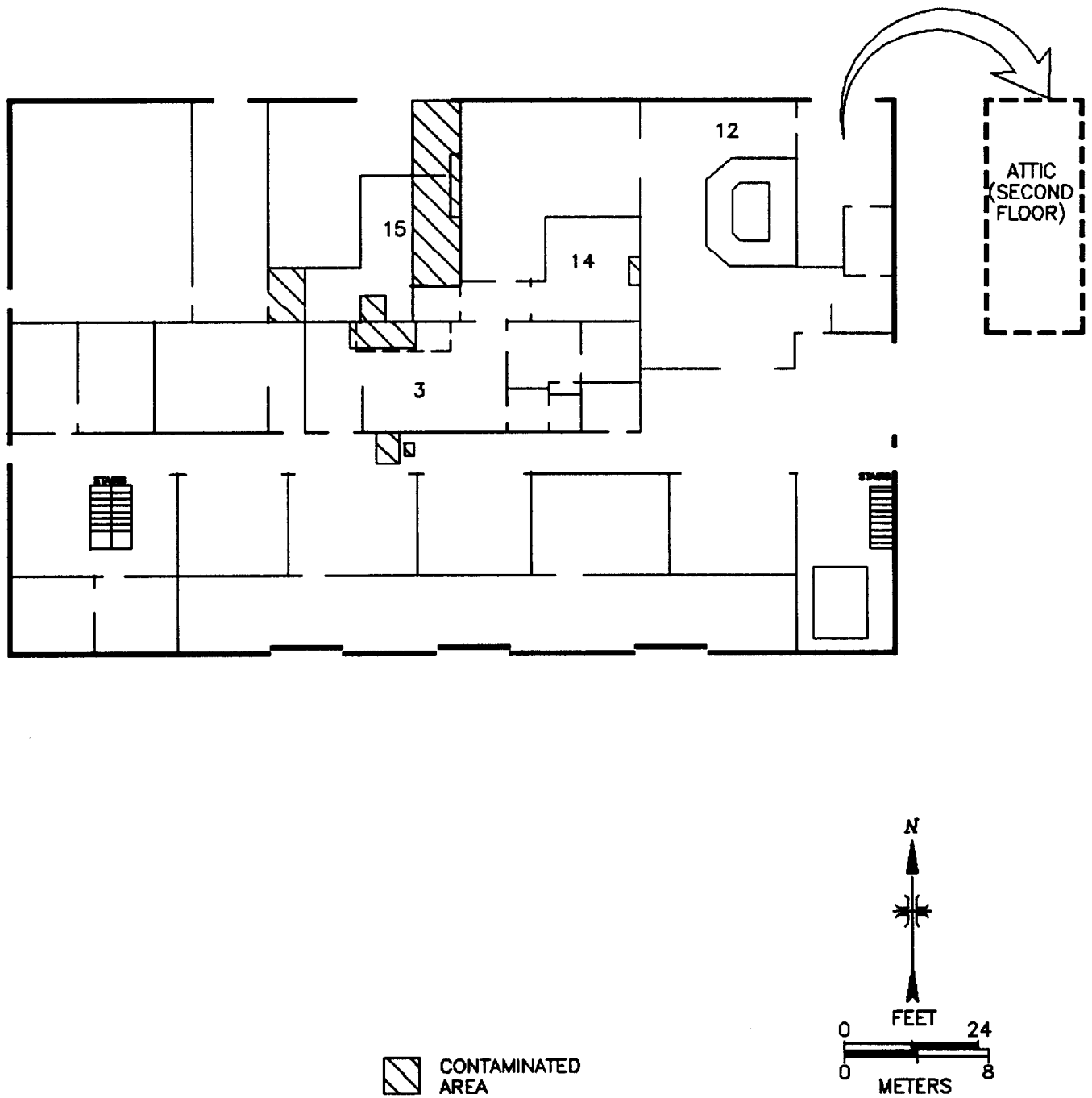


FIGURE 107: Plot Plan of Building 28, First Floor

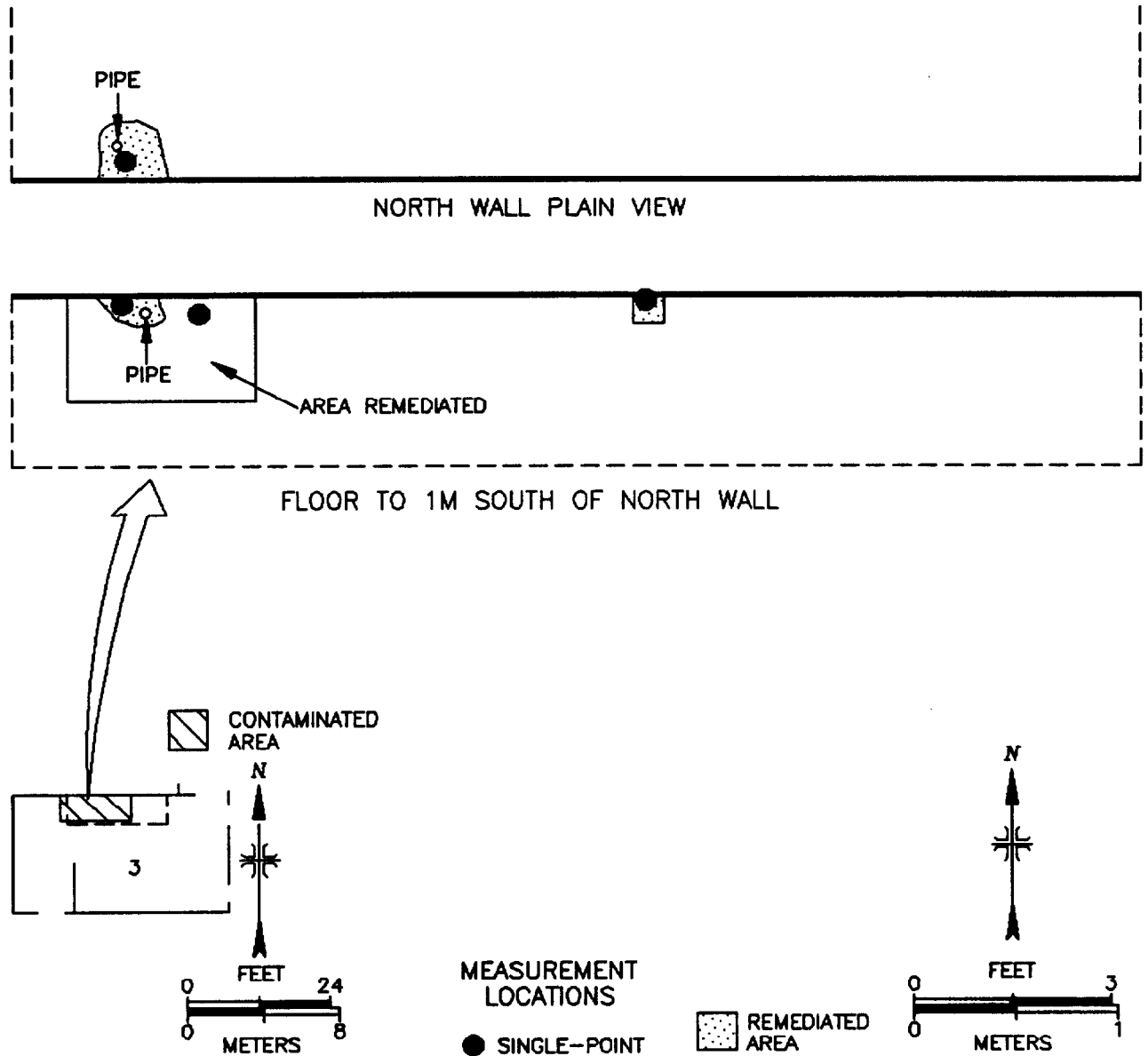


FIGURE 108: Building 28, Room 3 Floor and North Wall – Remediated Areas and Measurement Locations

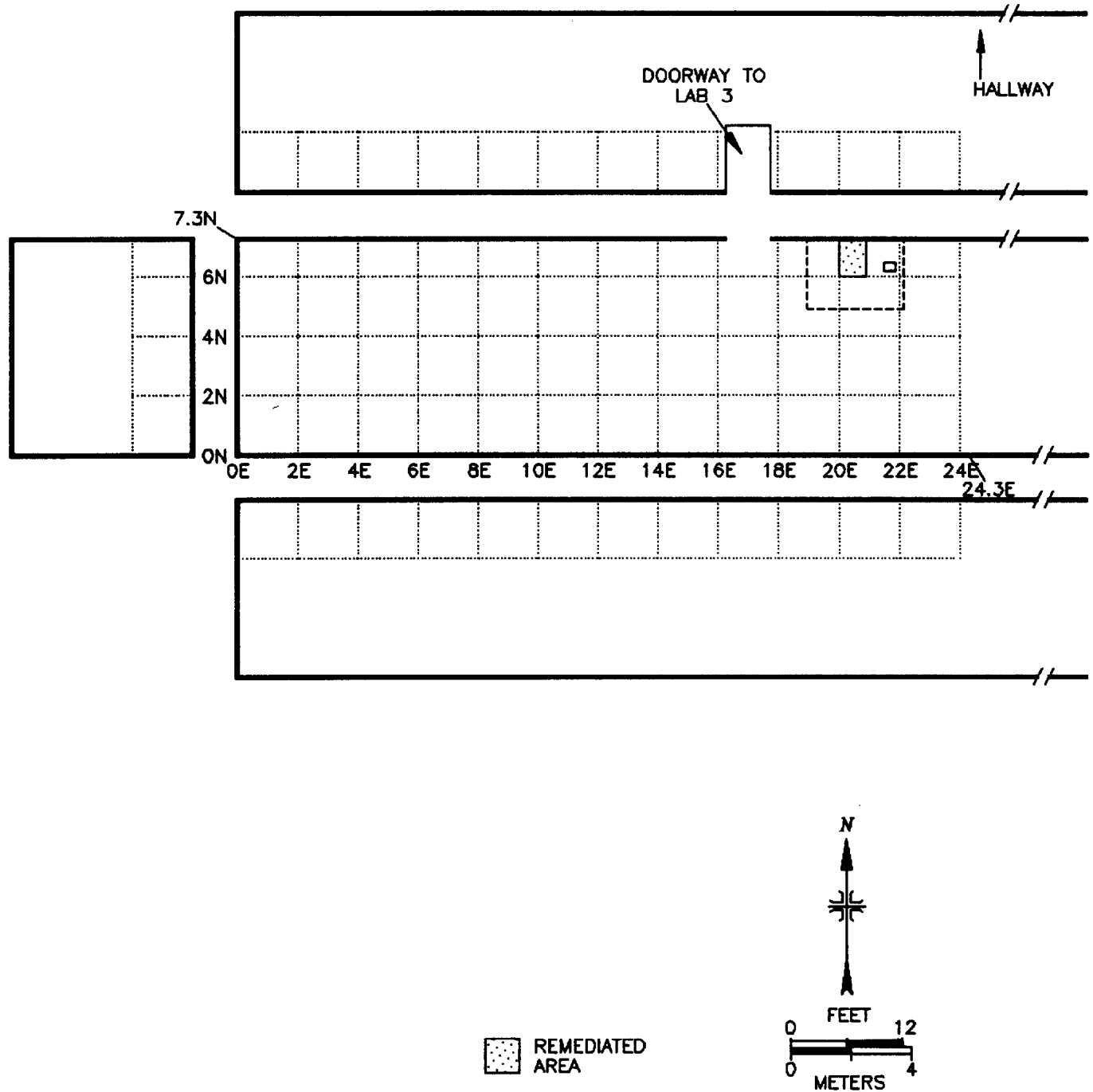


FIGURE 109: Building 28, First Floor Hallway Outside Lab 3

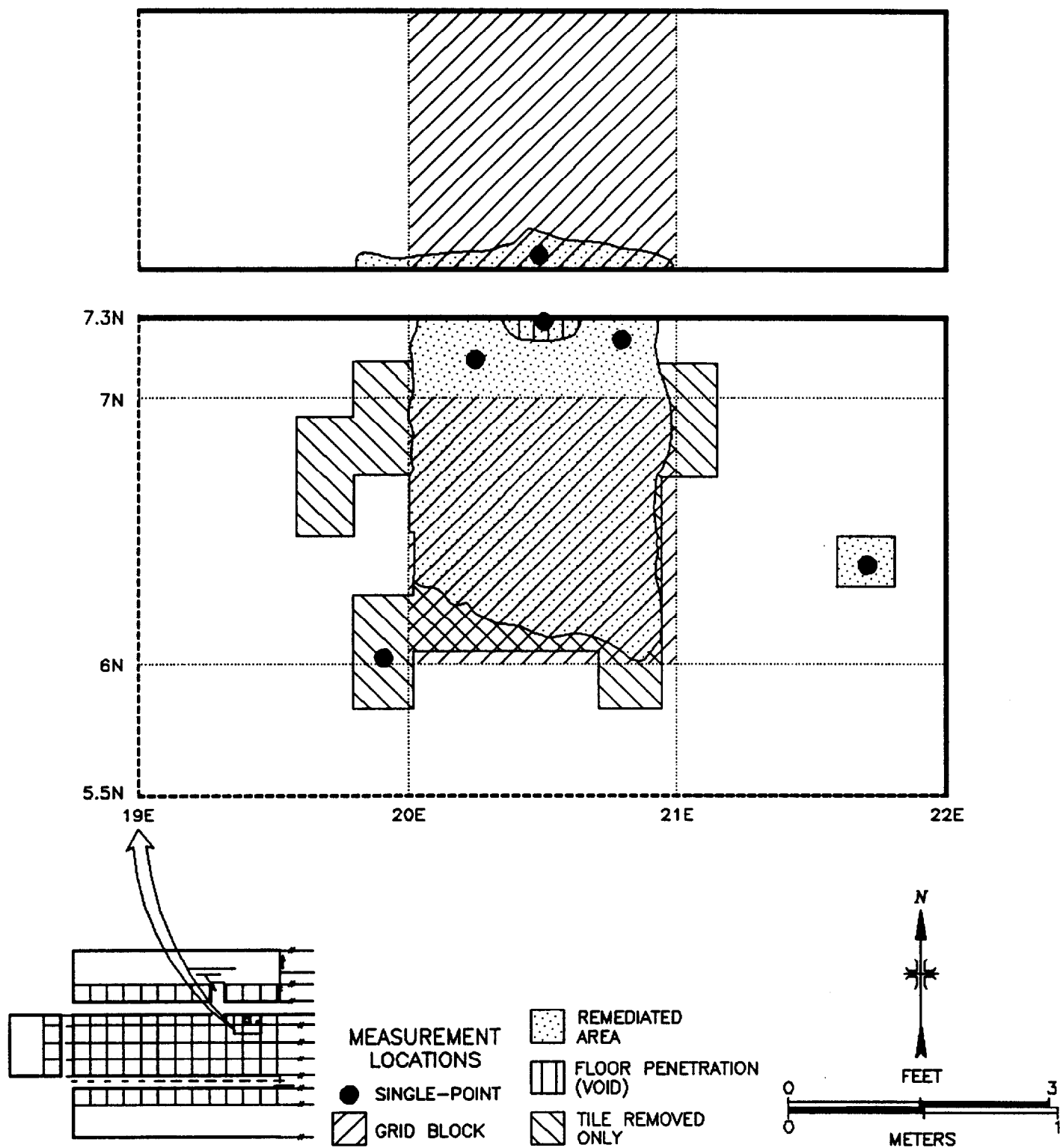


FIGURE 110: Building 28, First Floor Hallway Remediated Area Outside Lab 3 – Measurement and Sampling Locations

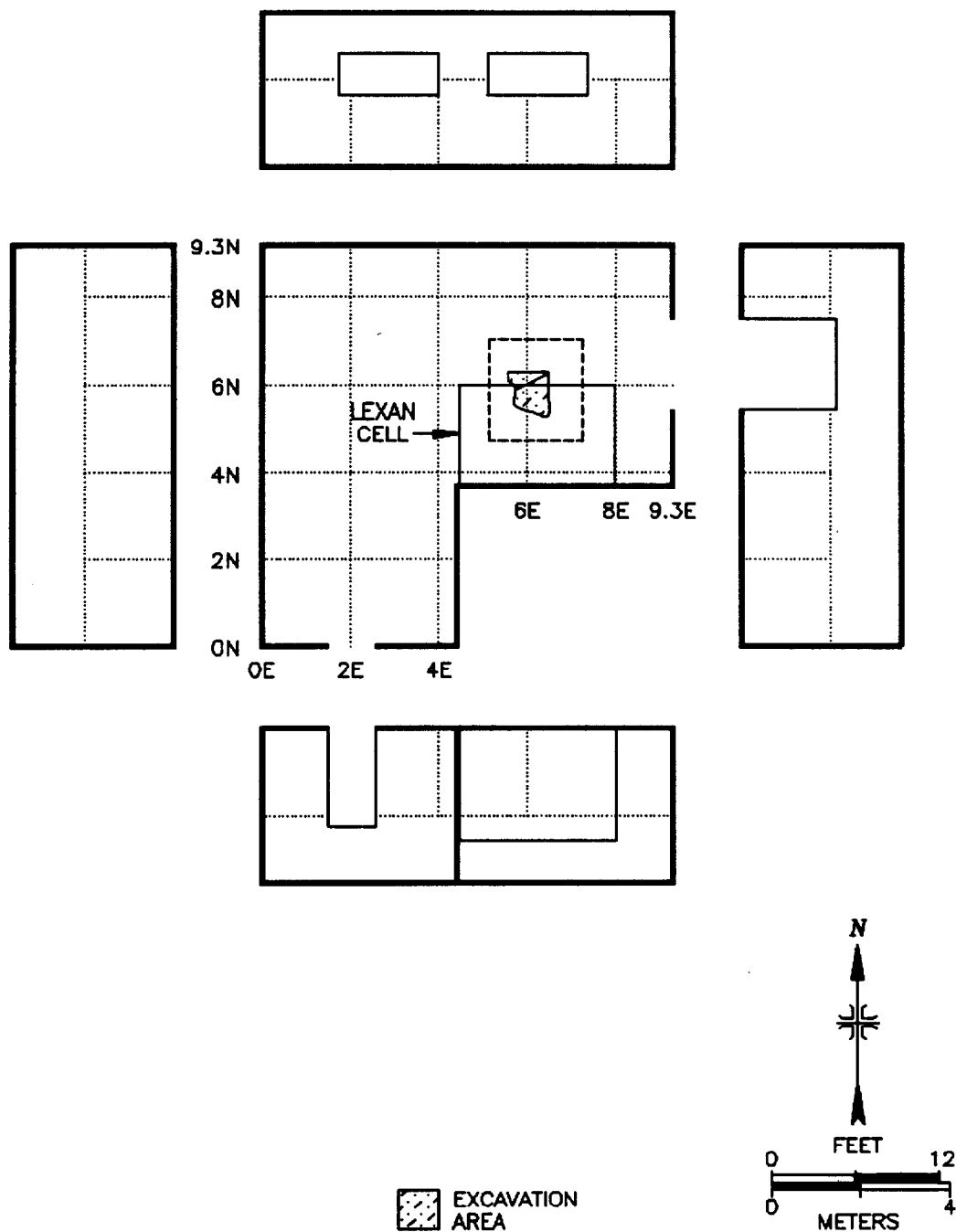


FIGURE 111: Building 28, First Floor, Lab 13 – Location of Excavation

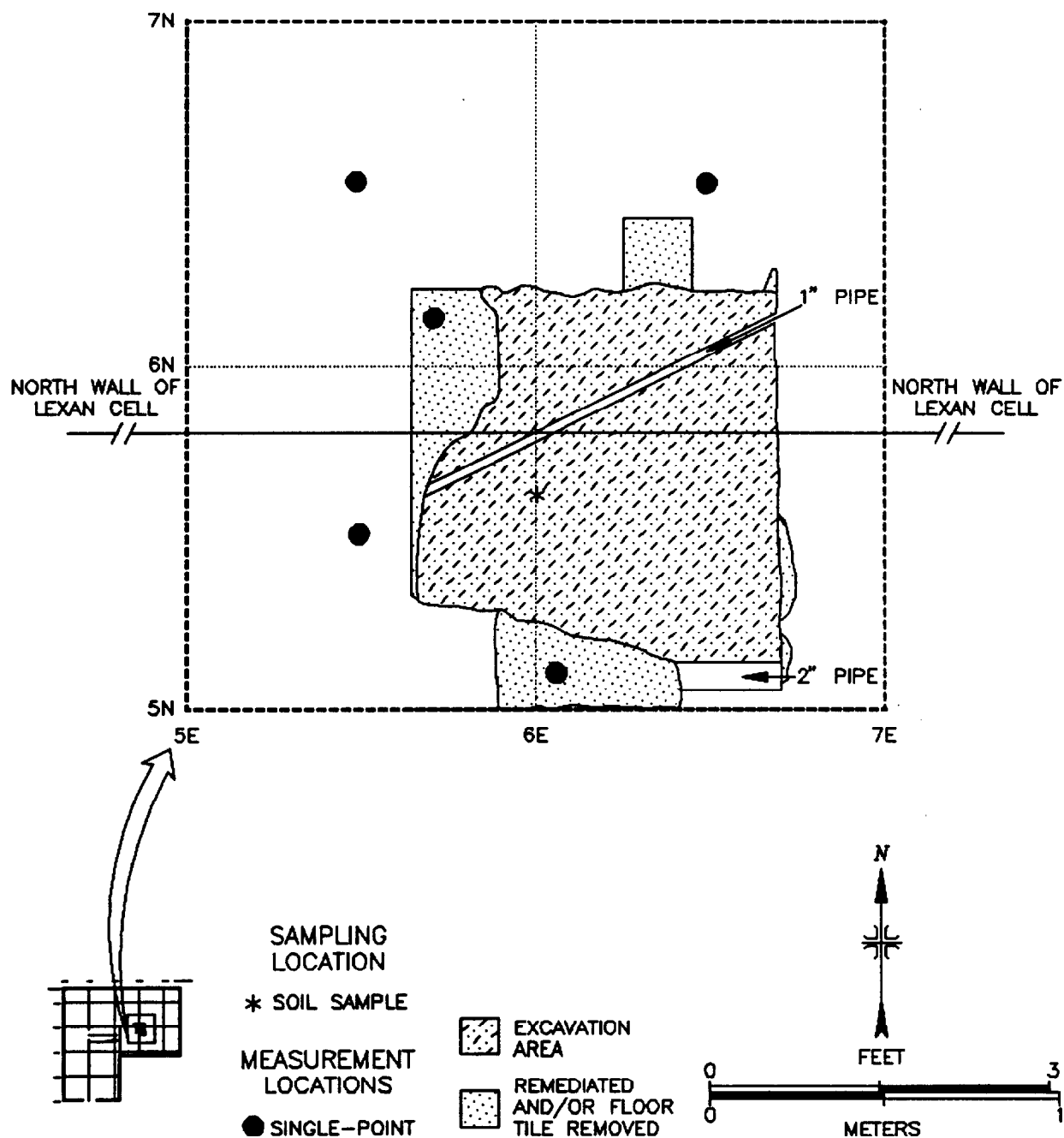


FIGURE 112: Building 28, First Floor, Lab 13 Breakout of Remediated Area – Remediated Area and Measurement and Sampling Locations

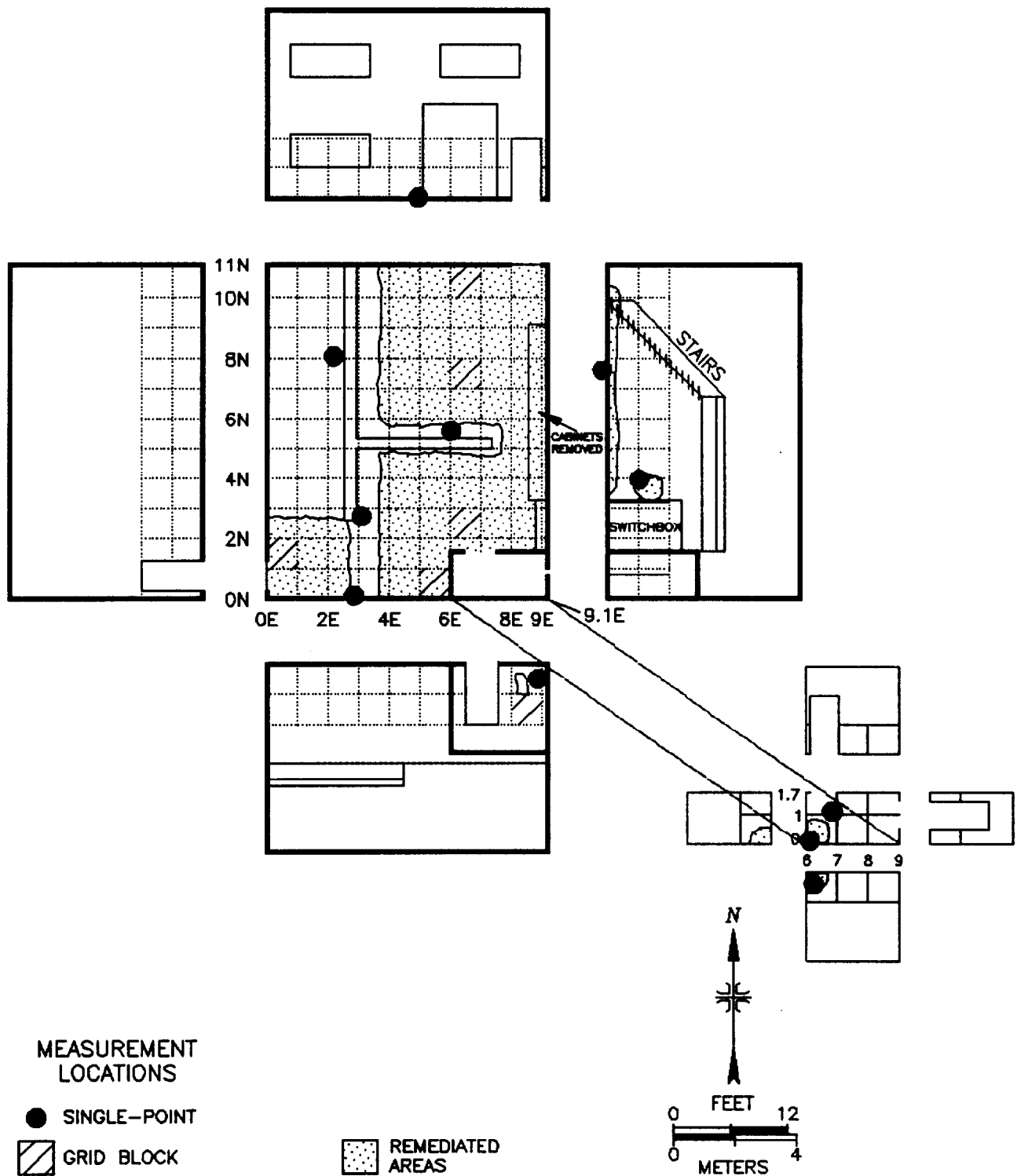
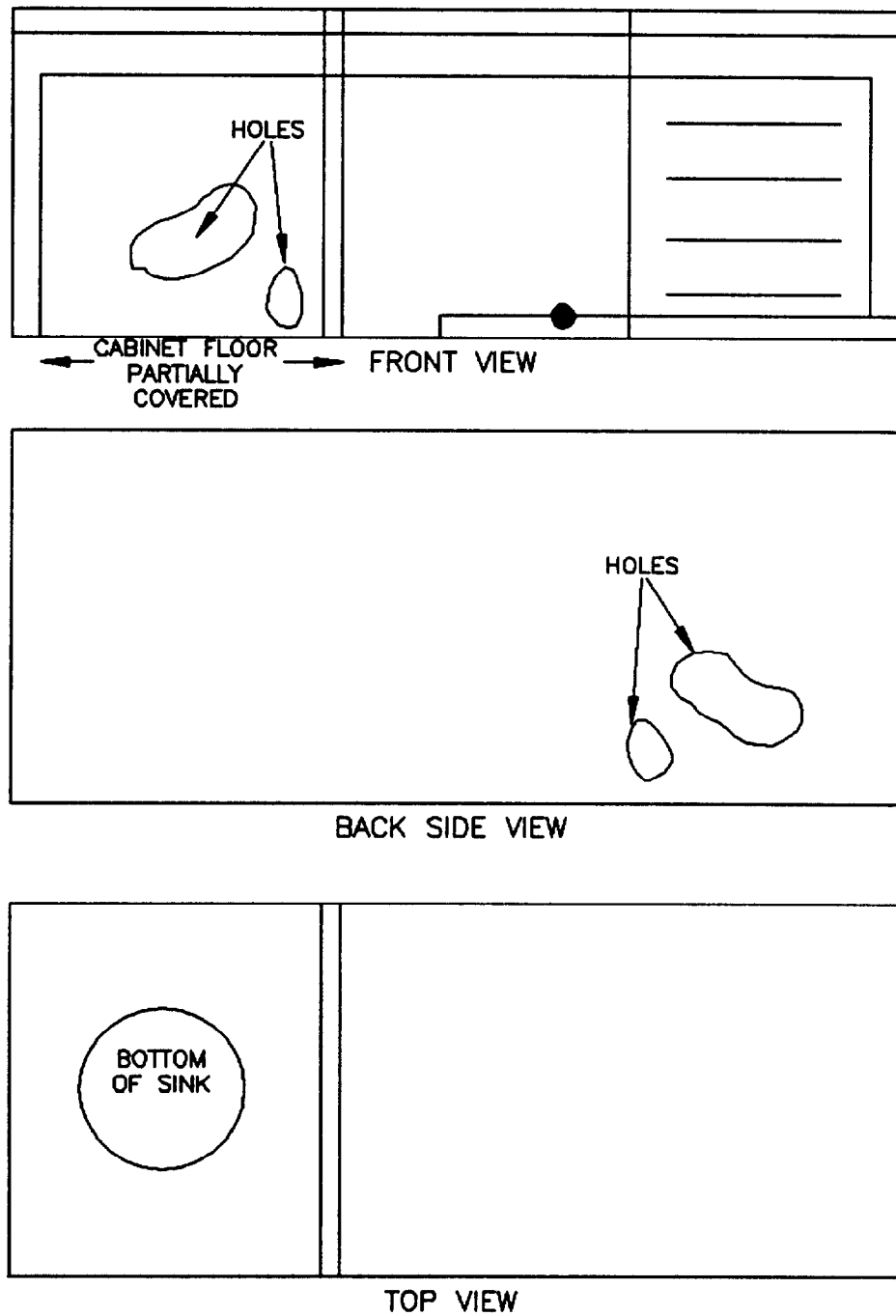


FIGURE 113: Building 28, Lab 15 – Remediated Areas and Measurement Locations



MEASUREMENT
LOCATION
● SINGLE-POINT

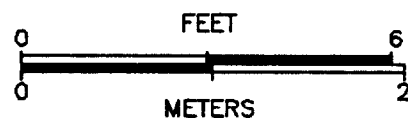


FIGURE 114: Building 28, Lab 15 Sink Cabinet – Measurement Locations

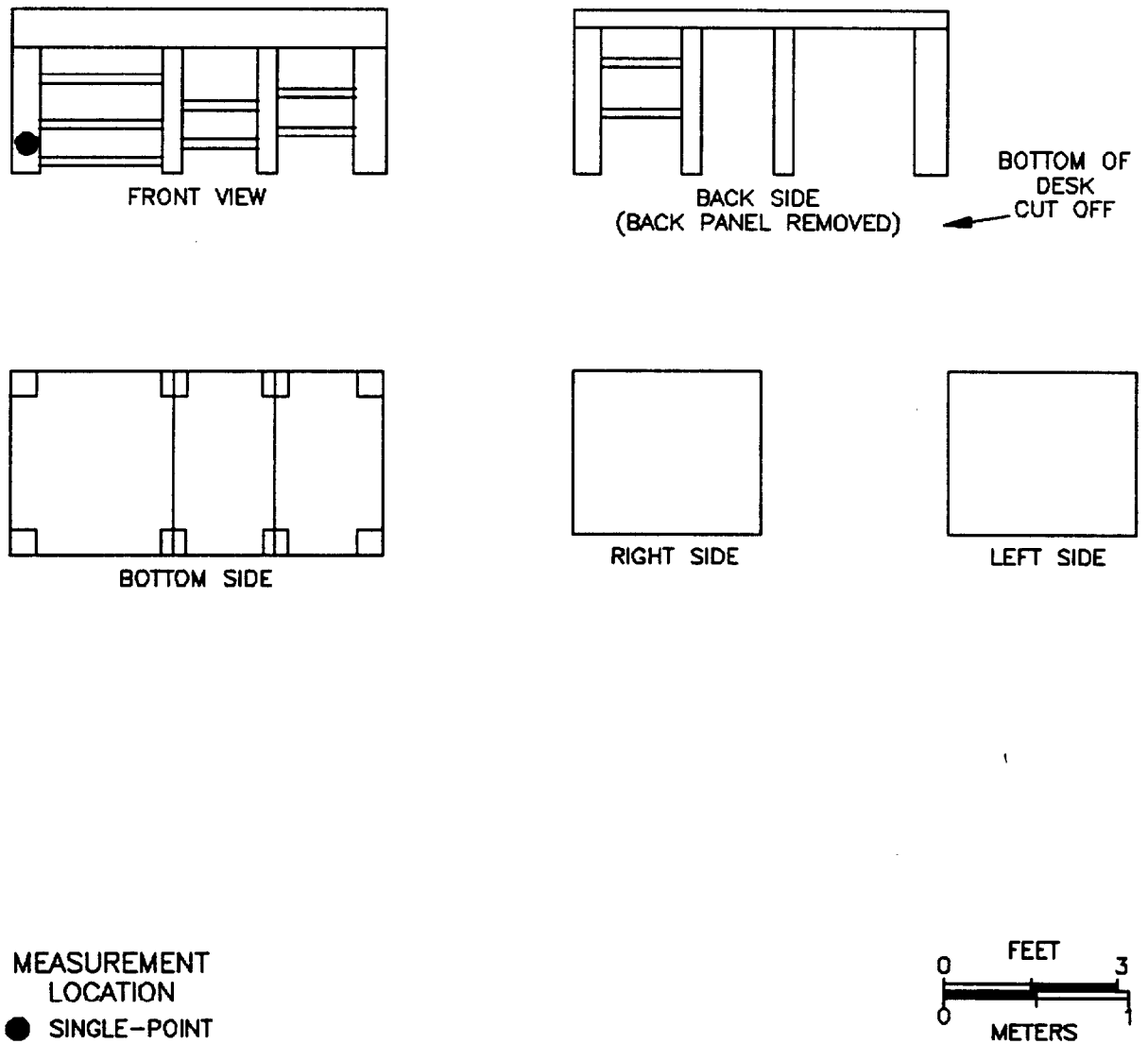


FIGURE 115: Building 28, Lab 15 Desk – Measurement Locations

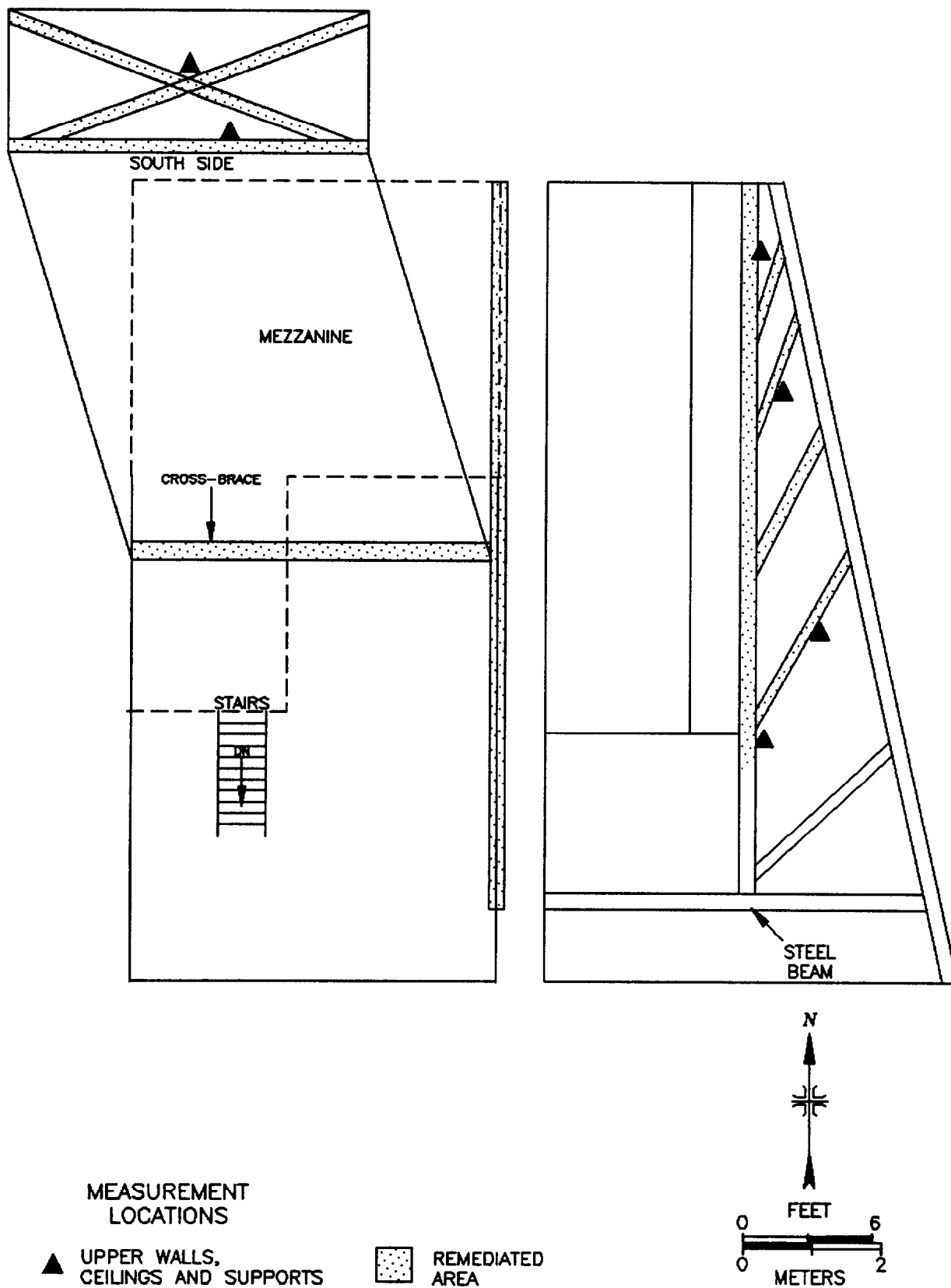


FIGURE 116: Building 28, Attic (Accessed from Lab 12) – Remediated Areas and Measurement and Sampling Locations

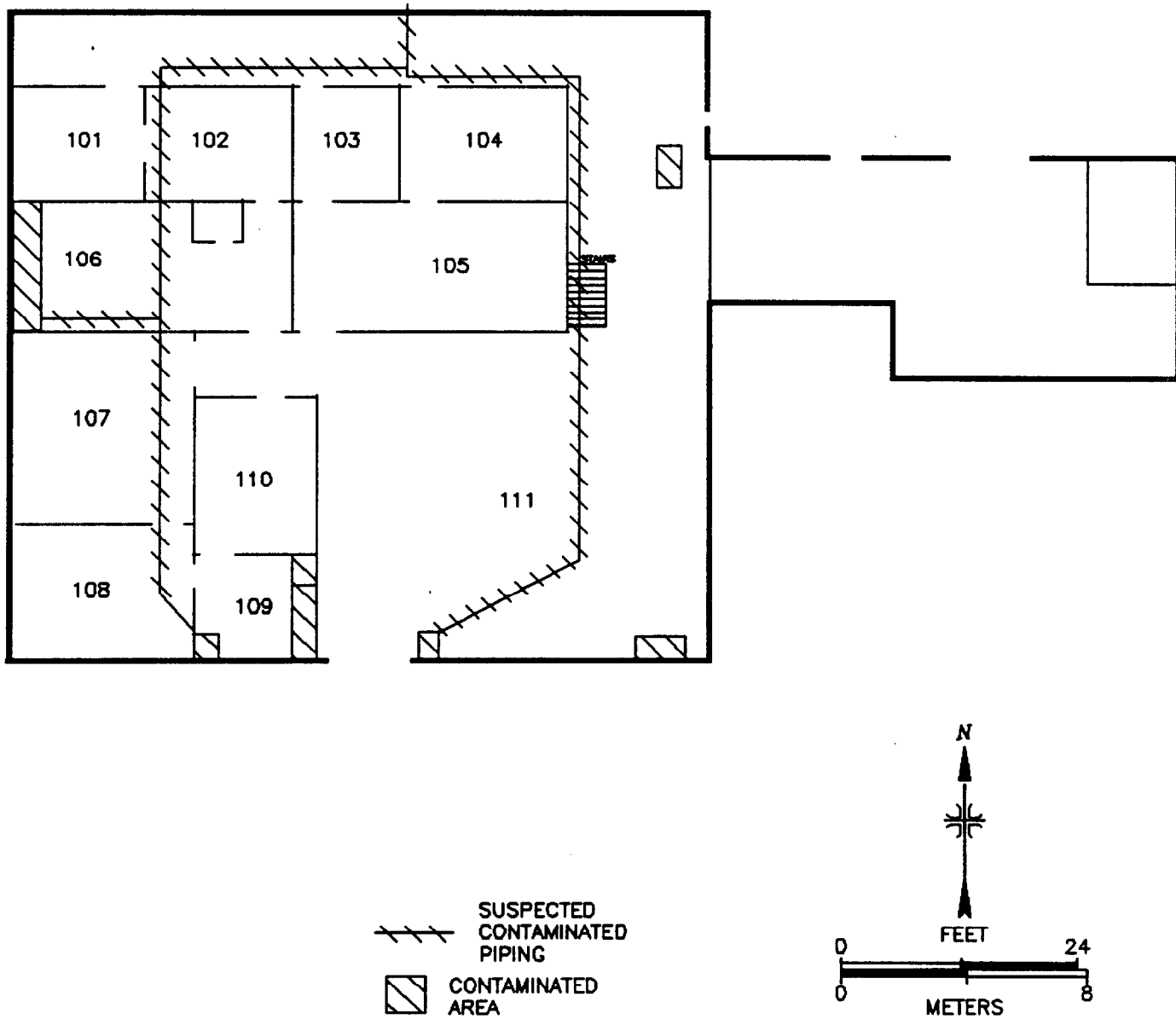


FIGURE 117: Plot Plan of Building 29, First Floor

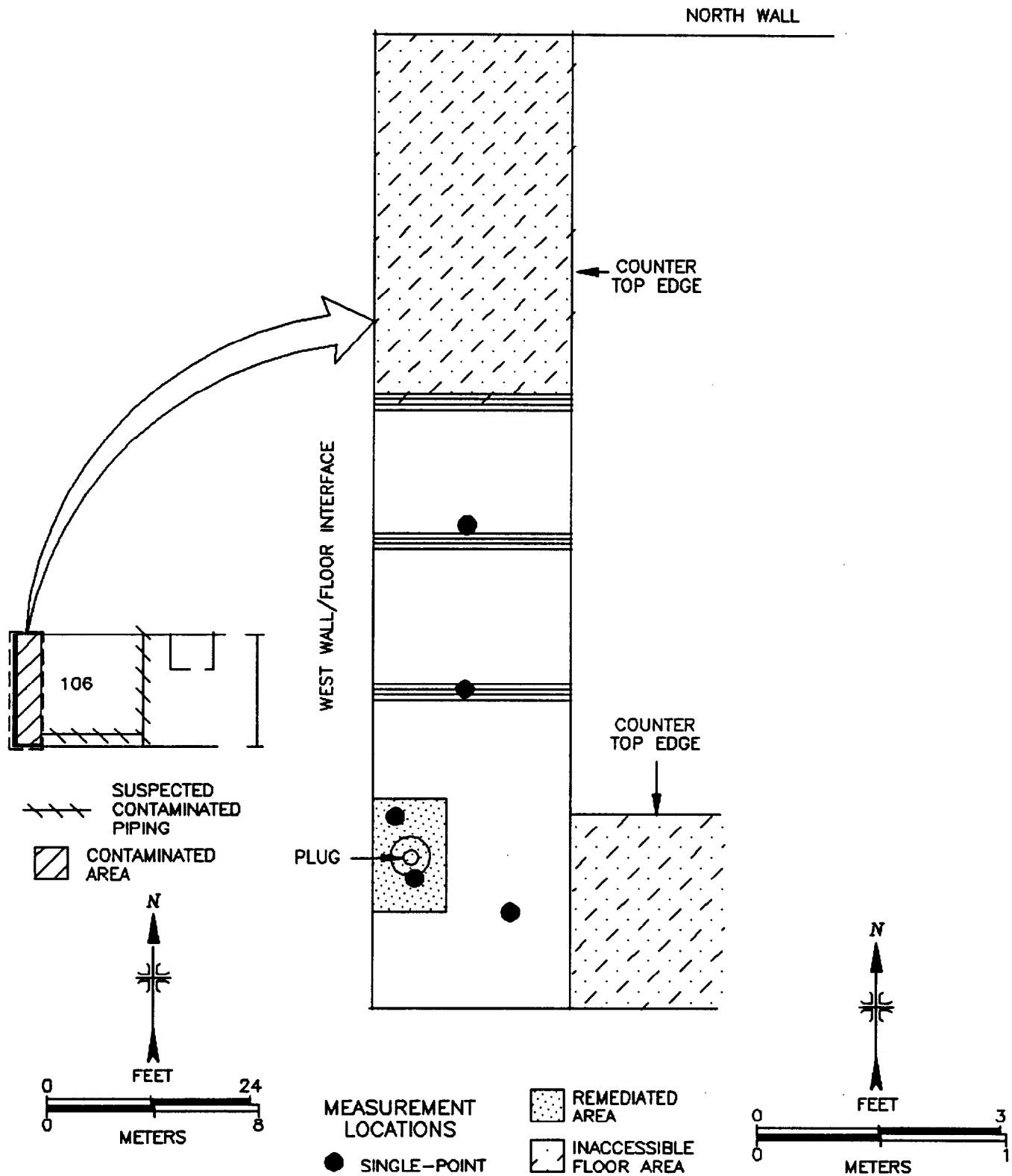


FIGURE 118: Building 29, Room 106, Floor Beneath Counters – Measurement Locations

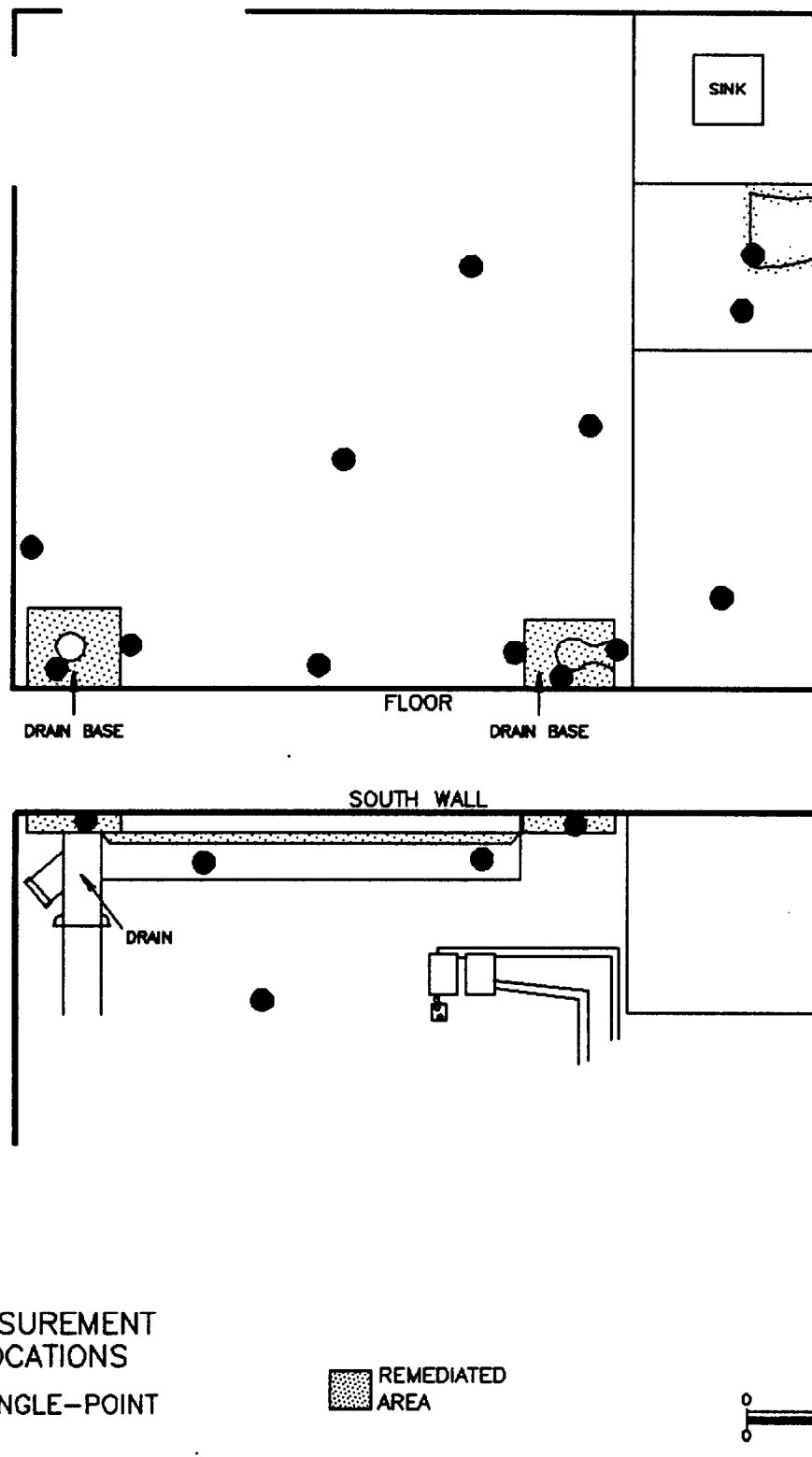


FIGURE 119: Building 29, Room 109 Floor and South Wall – Remediated Areas and Measurement Locations

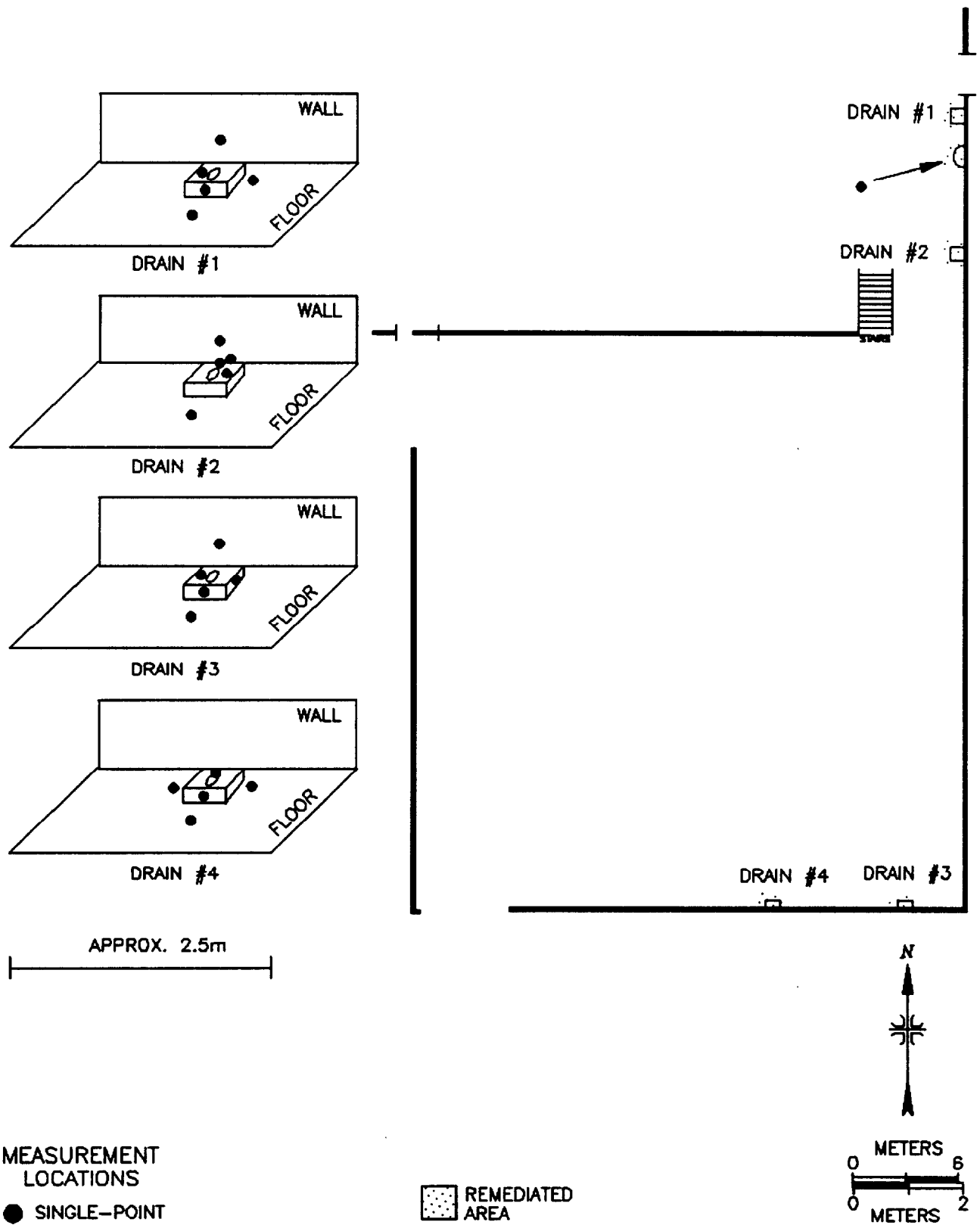


FIGURE 120: Building 29, Room 111 Floor, Lower Walls, and Drain Pedestals – Remediated Areas and Measurement Locations

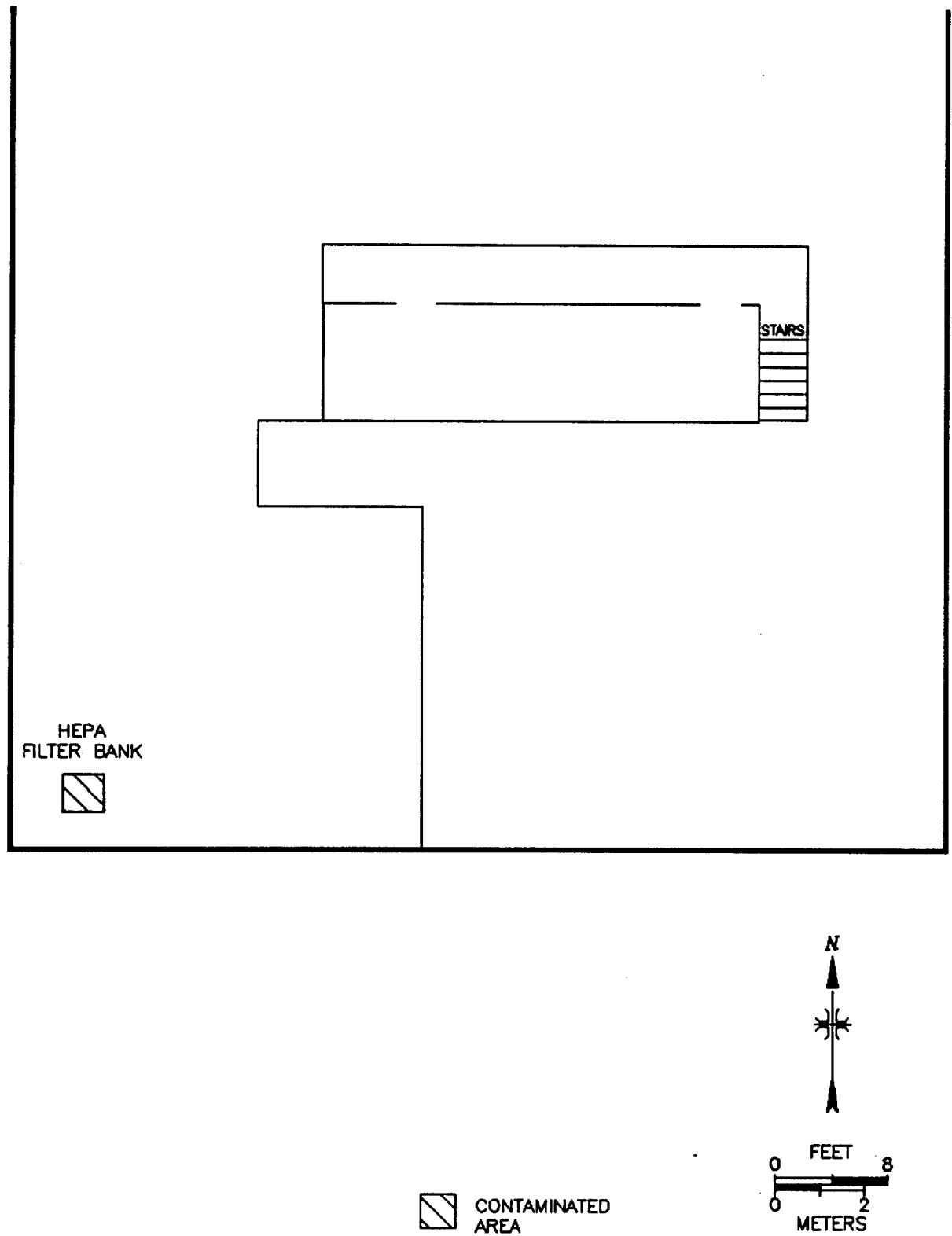


FIGURE 121: Plot Plan of Building 29, Second Floor

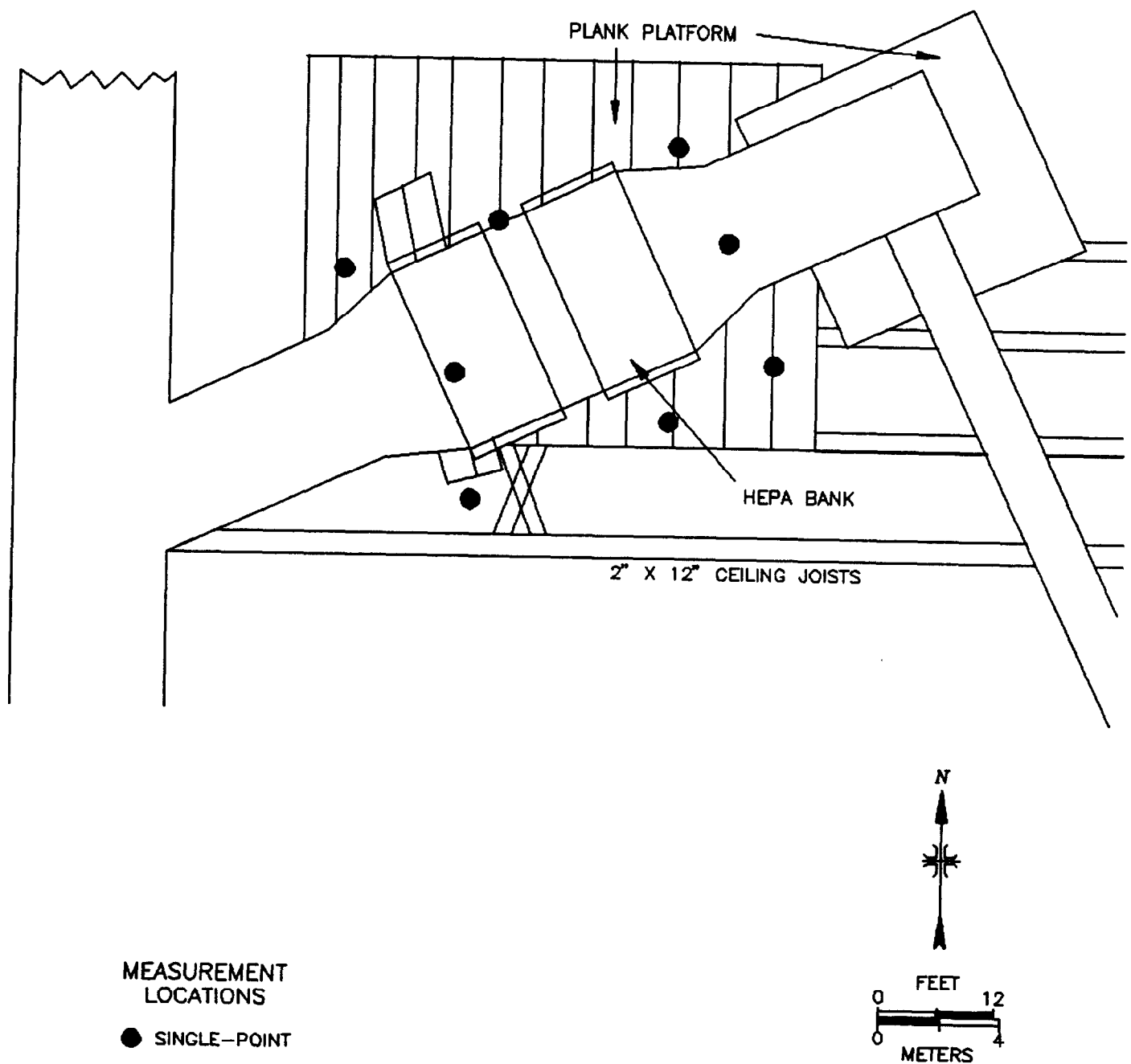


FIGURE 122: Building 29, Room 113, HEPA Filter Bank - Measurement Locations

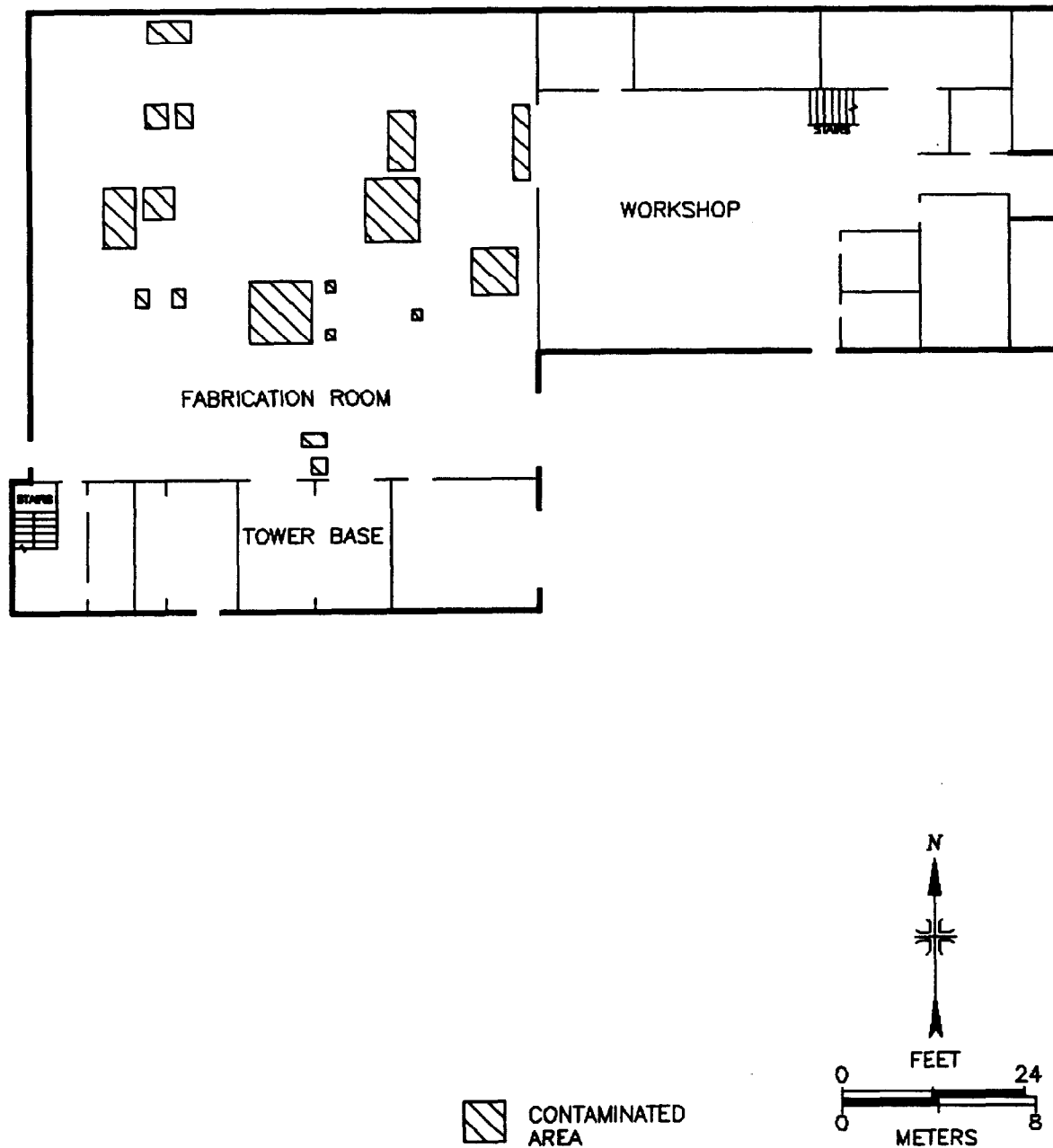


FIGURE 123: Plot Plan of Building 30, First Floor

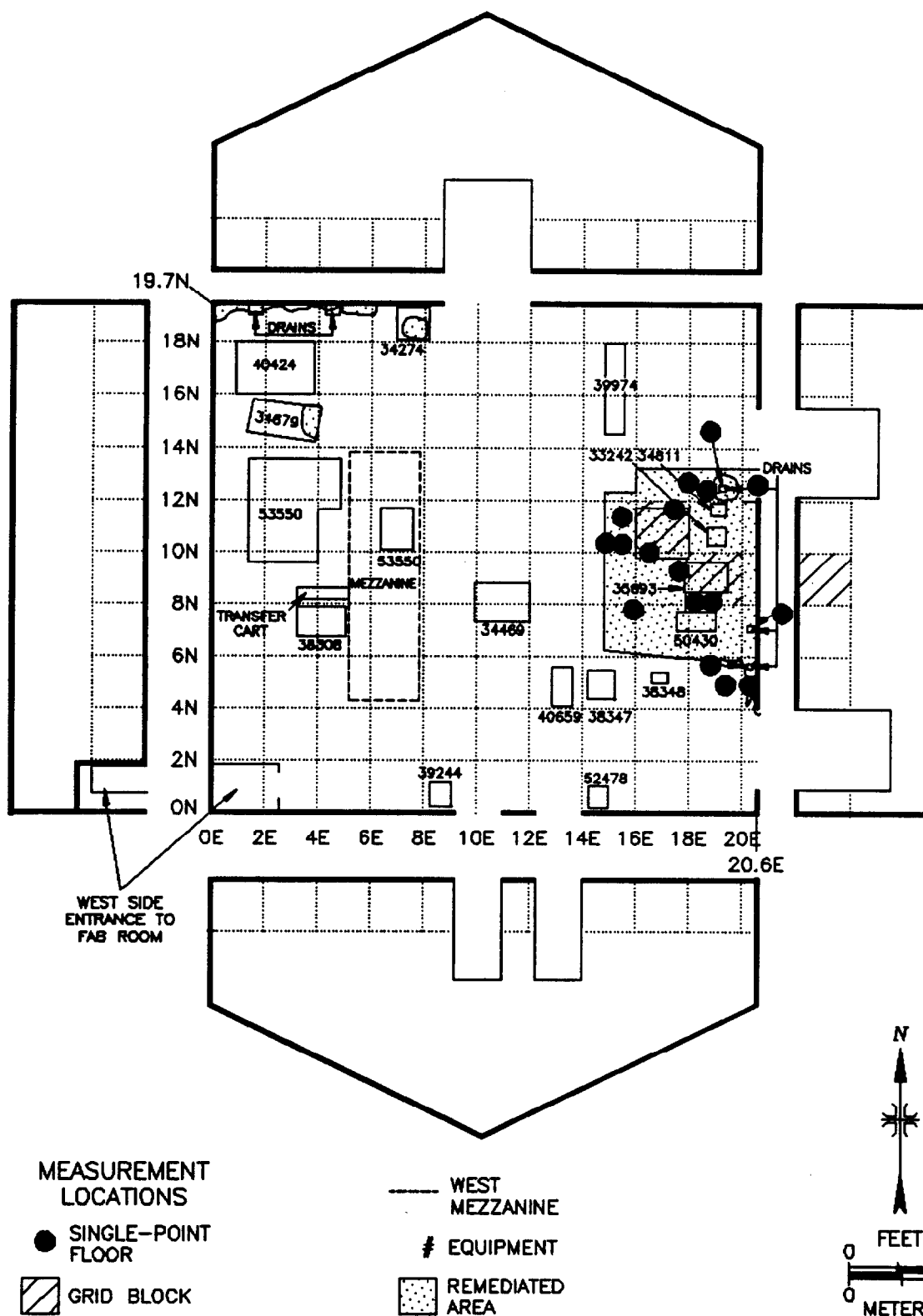


FIGURE 124: Building 30, Fabrication Room East Floor and Wall Equipment Locations – Remediated Areas and Measurement Locations

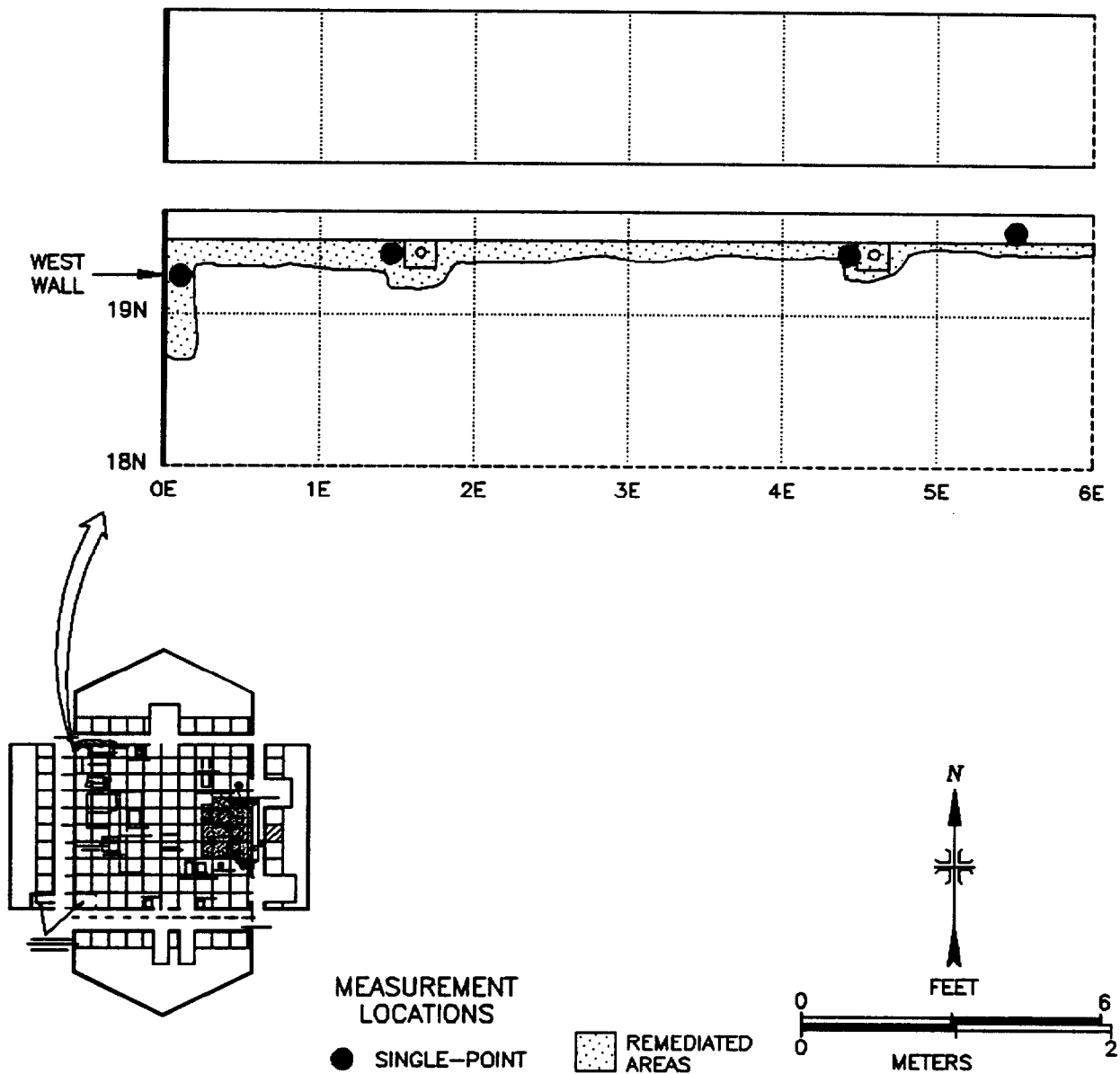


FIGURE 125: Building 30, Fabrication Room, North Wall Floor and Drains - Remediation Areas and Measurement Locations

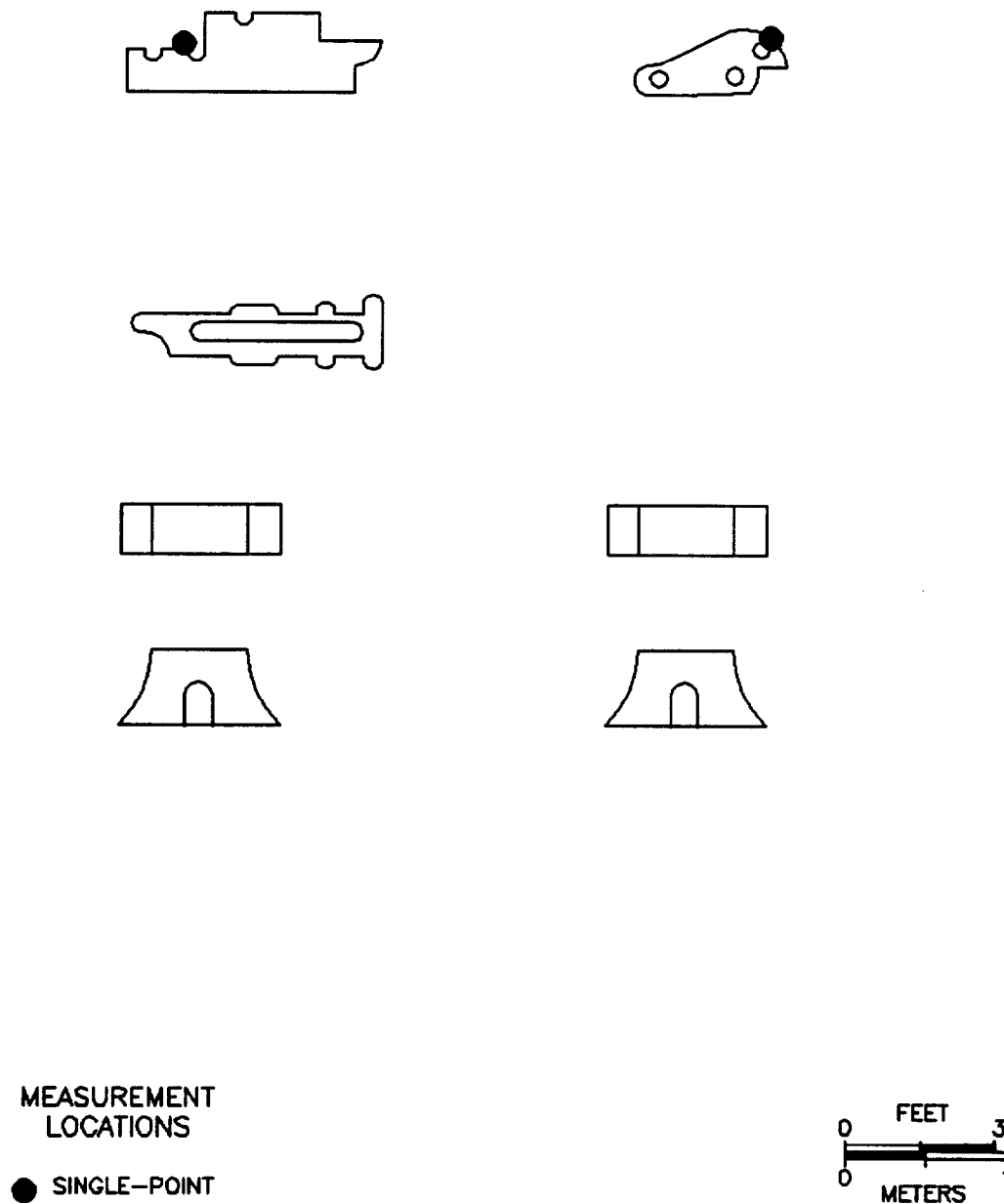


FIGURE 126: Building 30, Fabrication Room, Parts of Shear #33988 – Measurement Locations

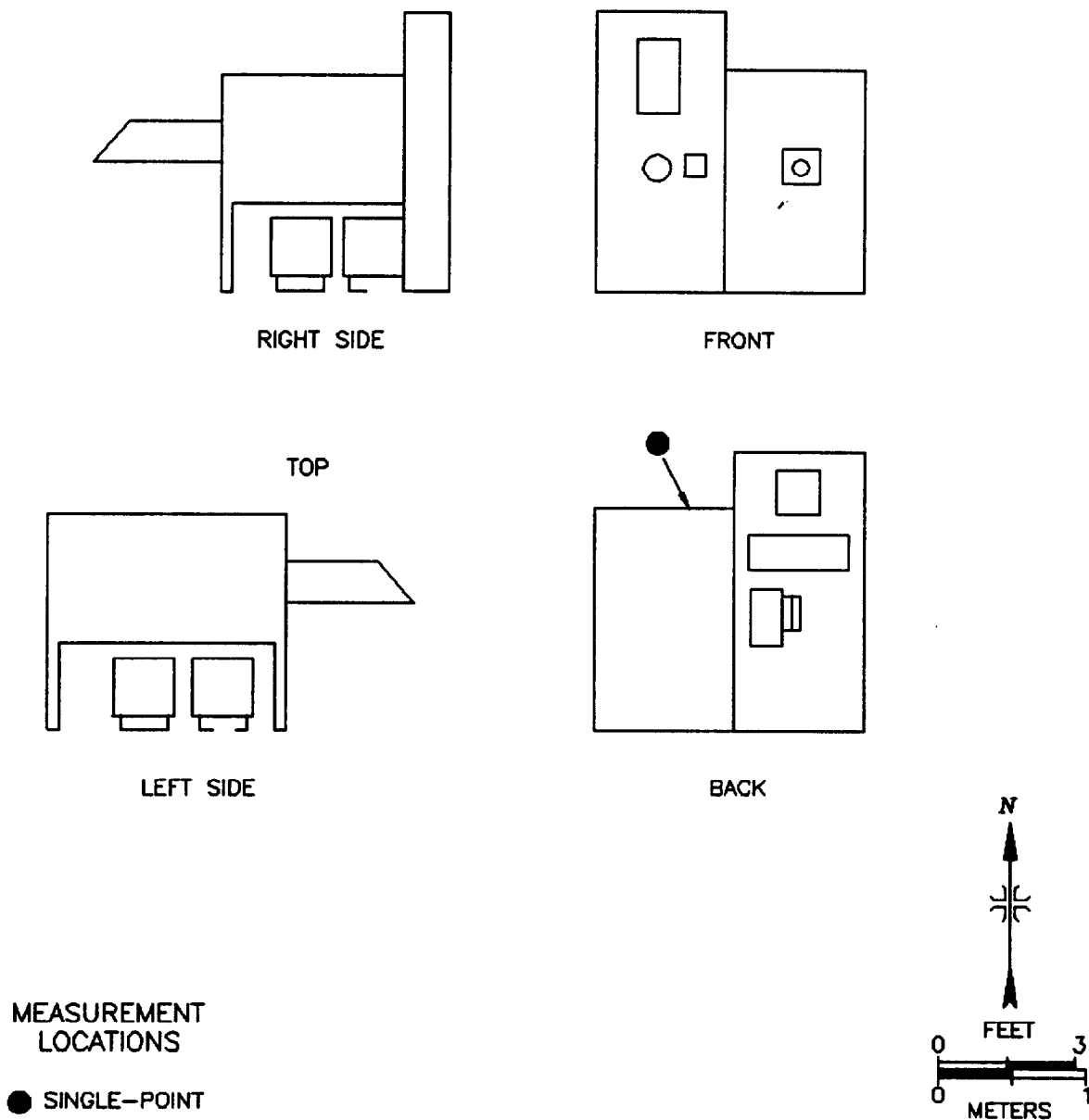


FIGURE 127: Building 30, Fabrication Room, Hydrogen Oven Equipment #50430 - Measurement Locations

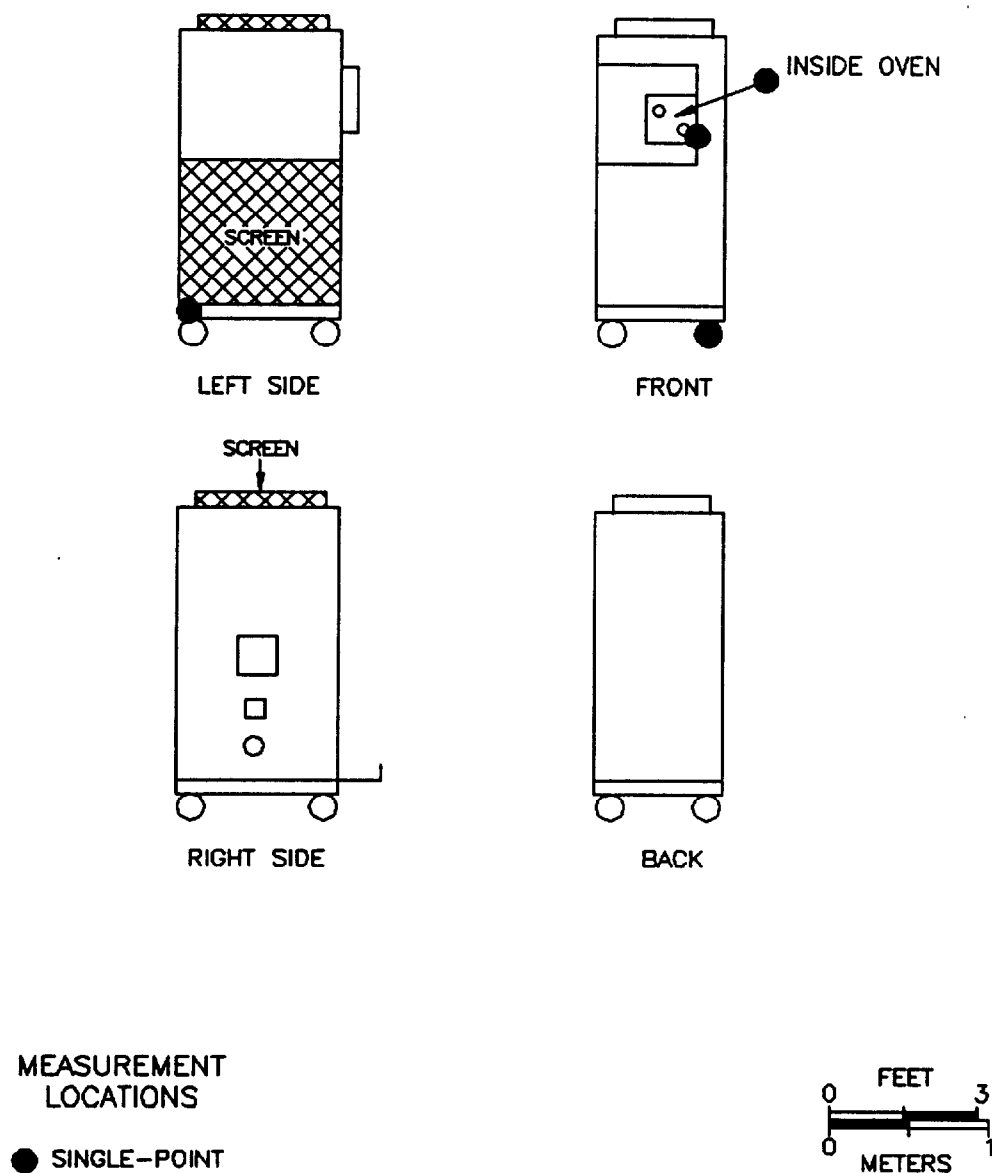


FIGURE 128: Building 30, Fabrication Room, Portable Keith Oven #52478 - Measurement Locations

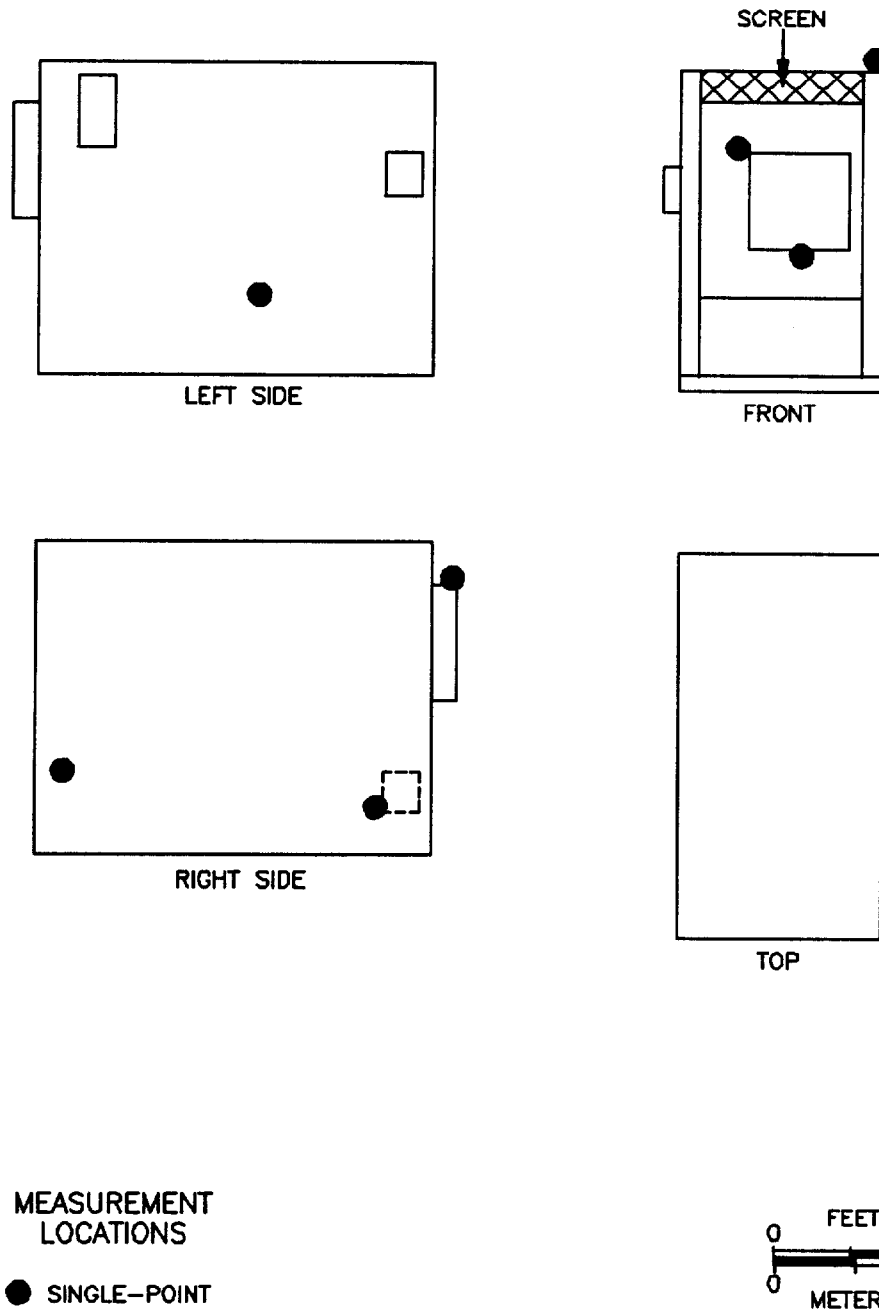
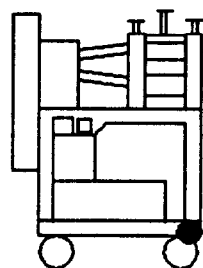
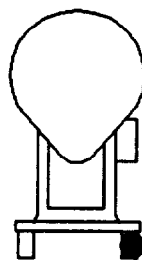


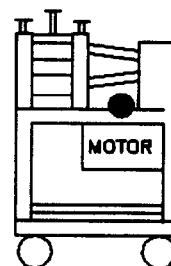
FIGURE 129: Building 30, Fabrication Room, Hevi-Duty Oven #35693 - Measurement Locations



FRONT



LEFT SIDE



RIGHT SIDE

MEASUREMENT
LOCATIONS

● SINGLE-POINT

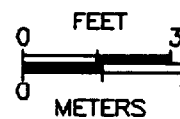


FIGURE 130: Building 30, Fabrication Room, Portable Rolling Mill
#52544 — Measurement Locations

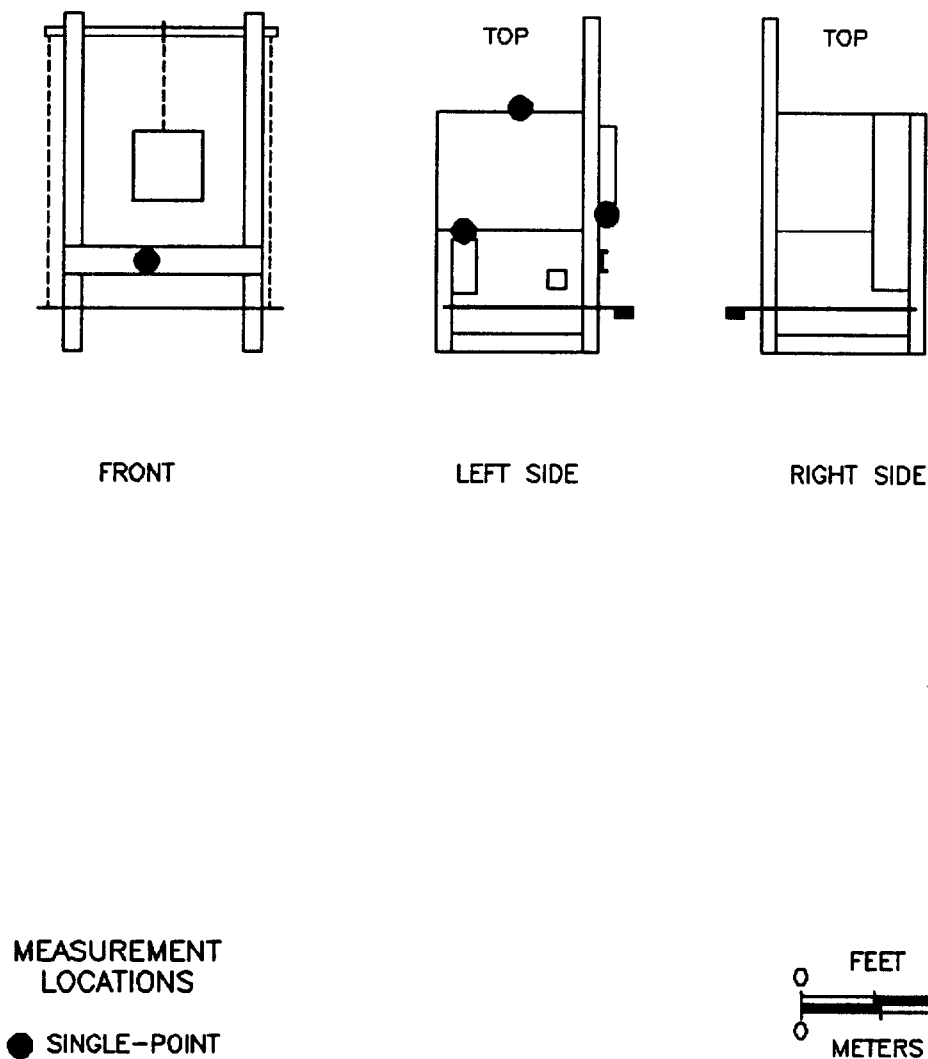
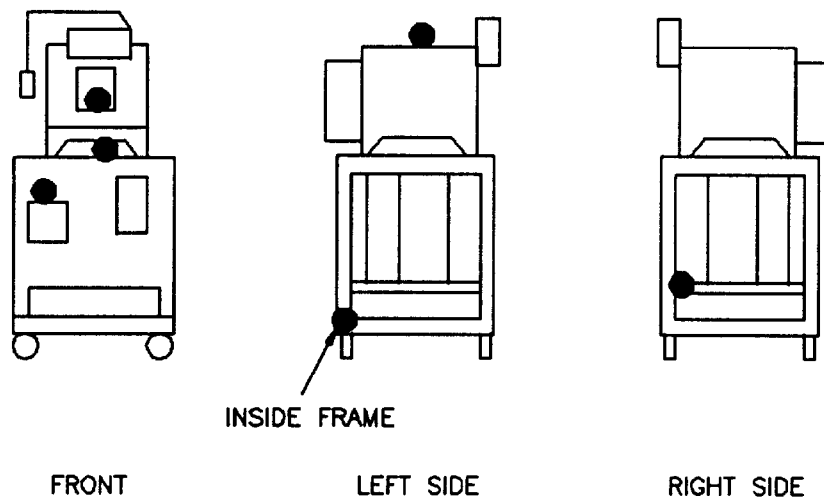


FIGURE 131: Building 30, Fabrication Room, Hoskins Furnace #39242 - Measurement Locations



MEASUREMENT
LOCATIONS

● SINGLE-POINT

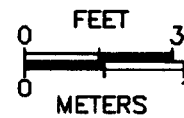


FIGURE 132: Building 30, Fabrication Room, Portable Electric Oven
#34840 — Measurement Locations

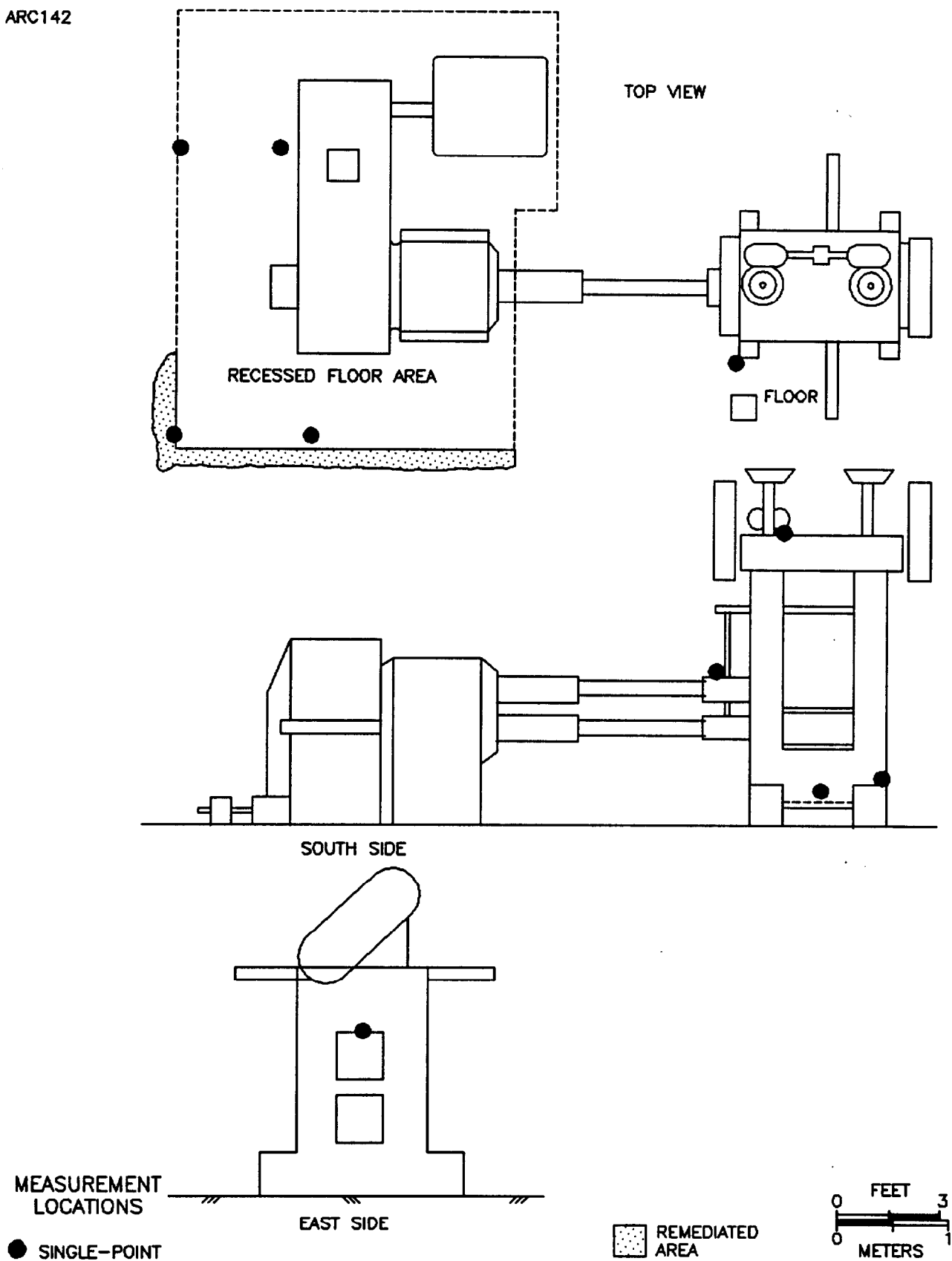


FIGURE 133: Building 30, Fabrication Room, Loma Roller #53550 – Remediated Area and Measurement Locations

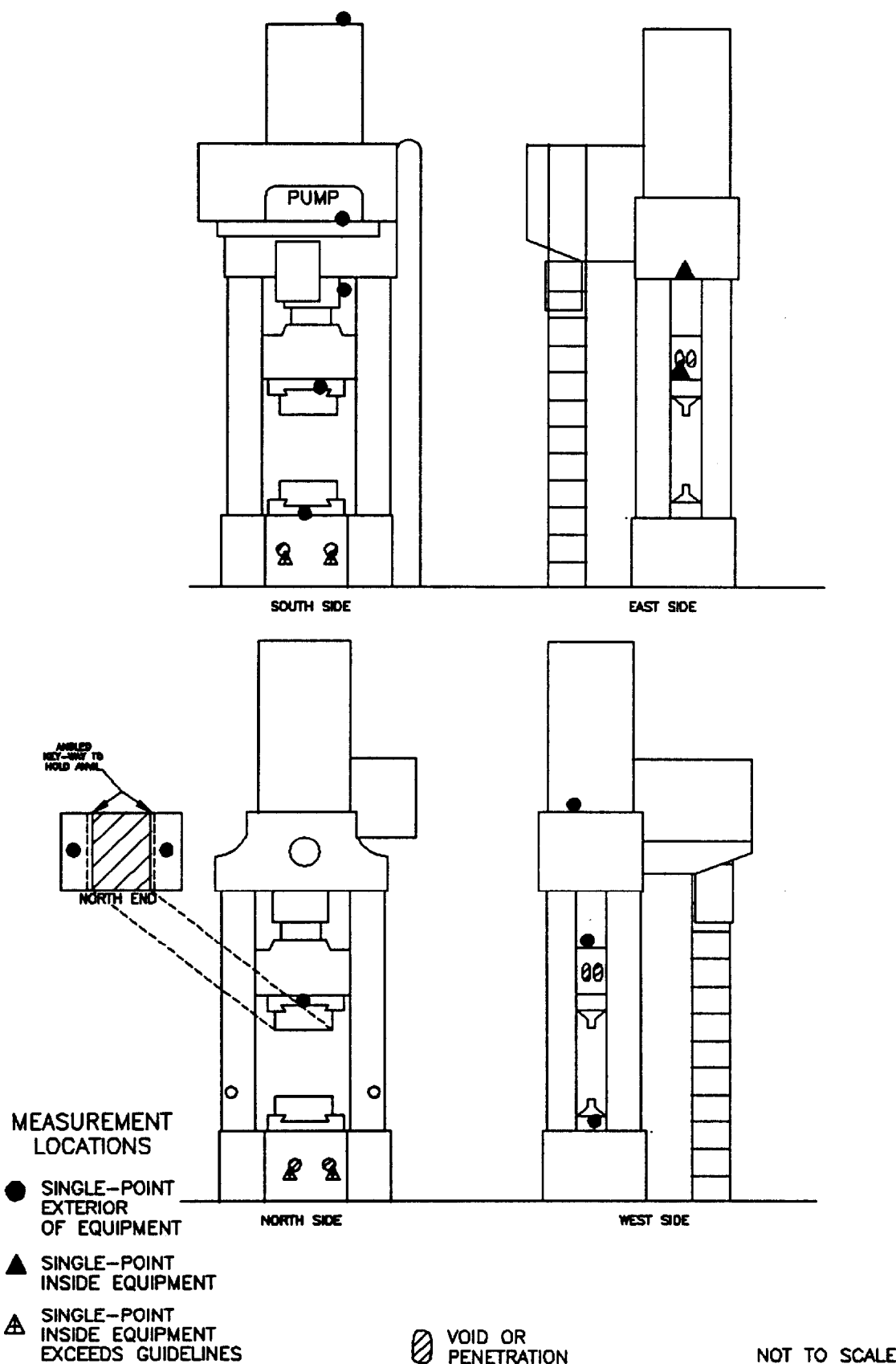


FIGURE 134: Building 30, Fabrication Room, HPM Hydraulic Press #34469 - Measurement Locations

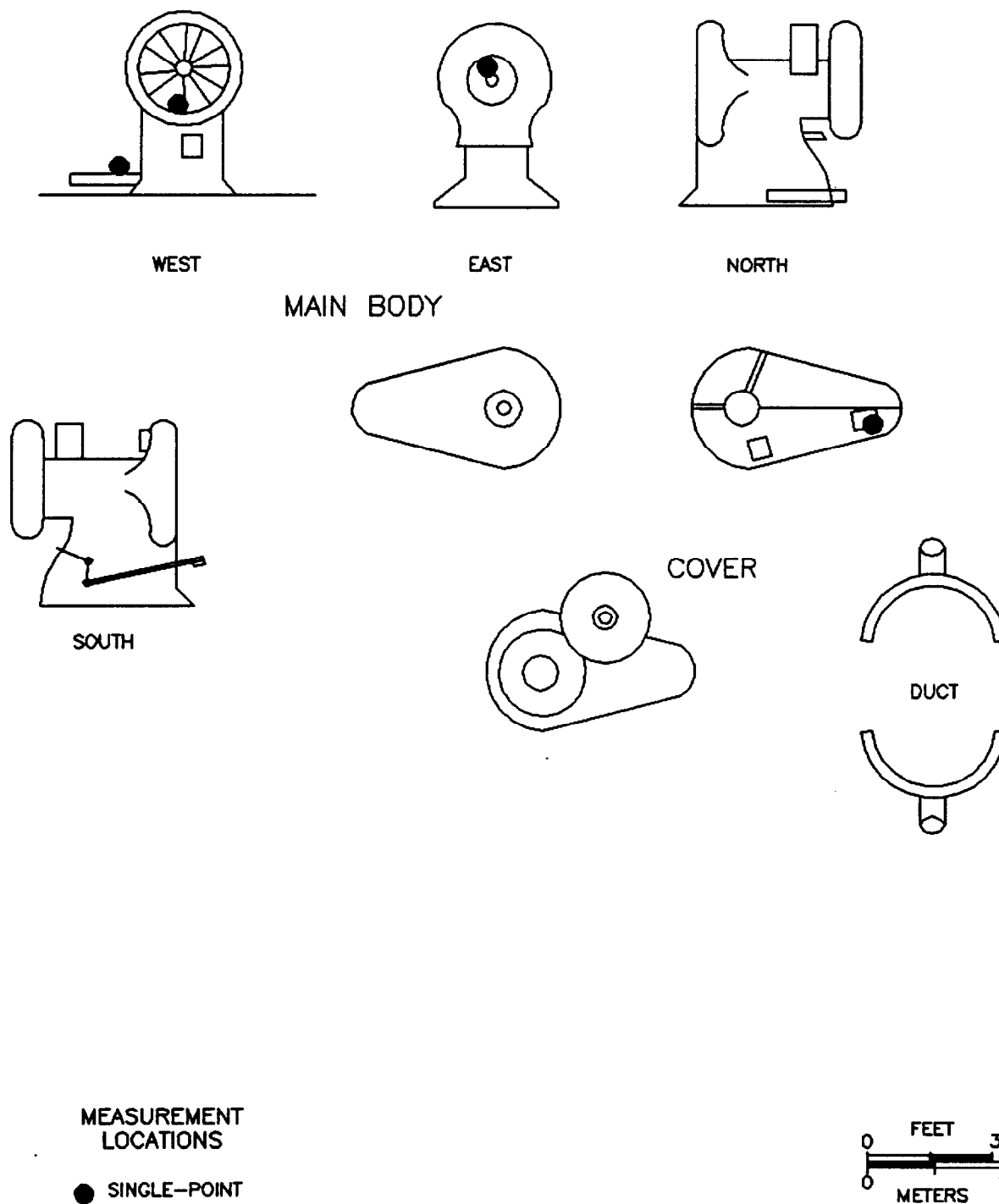


FIGURE 135: Building 30, Fabrication Room, Extruder #40659 – Measurement Locations

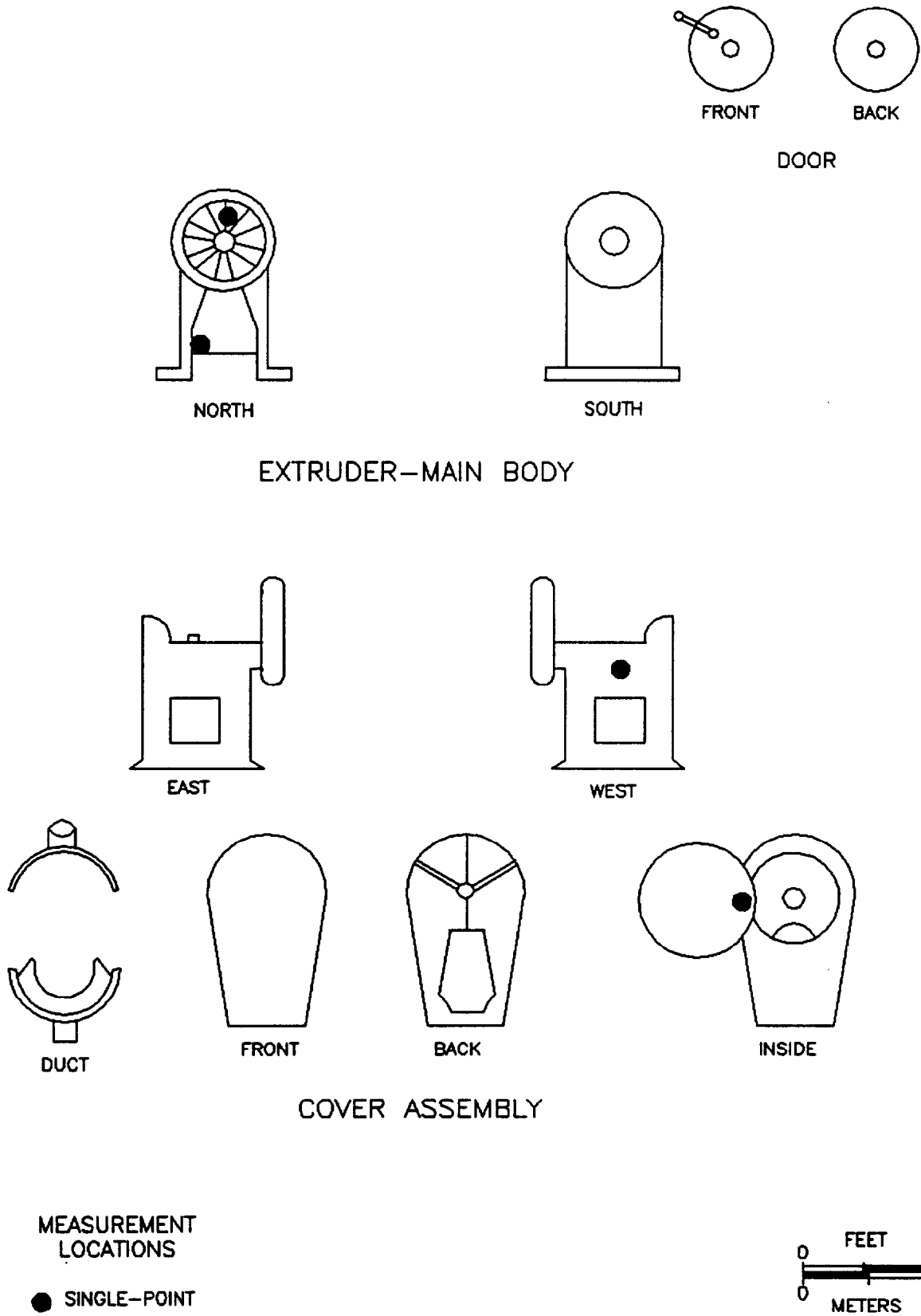


FIGURE 136: Building 30, Fabrication Room, Extruder #38347 – Measurement Locations

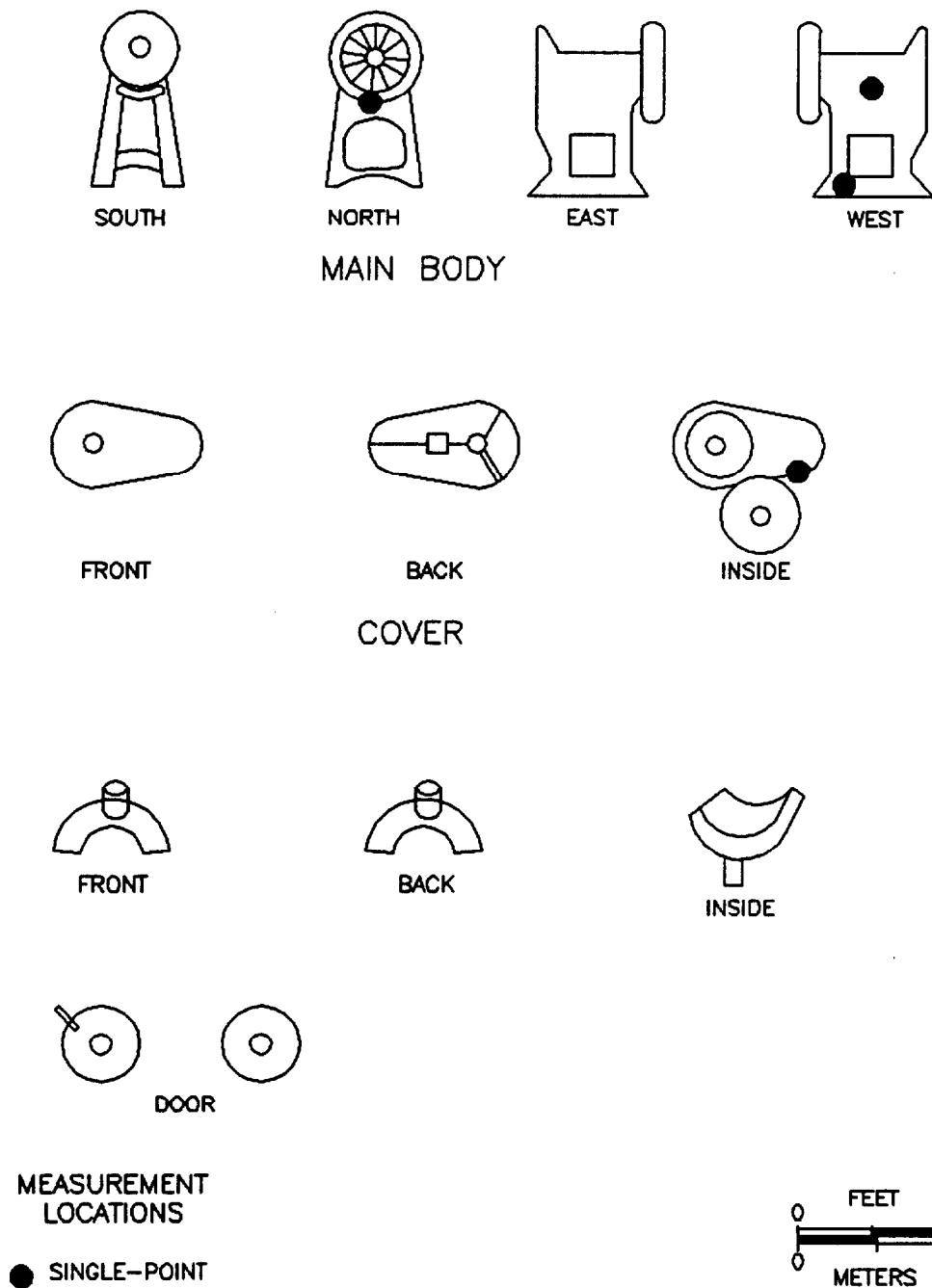


FIGURE 137: Building 30, Fabrication Room, Extruder #38348 - Measurement Locations

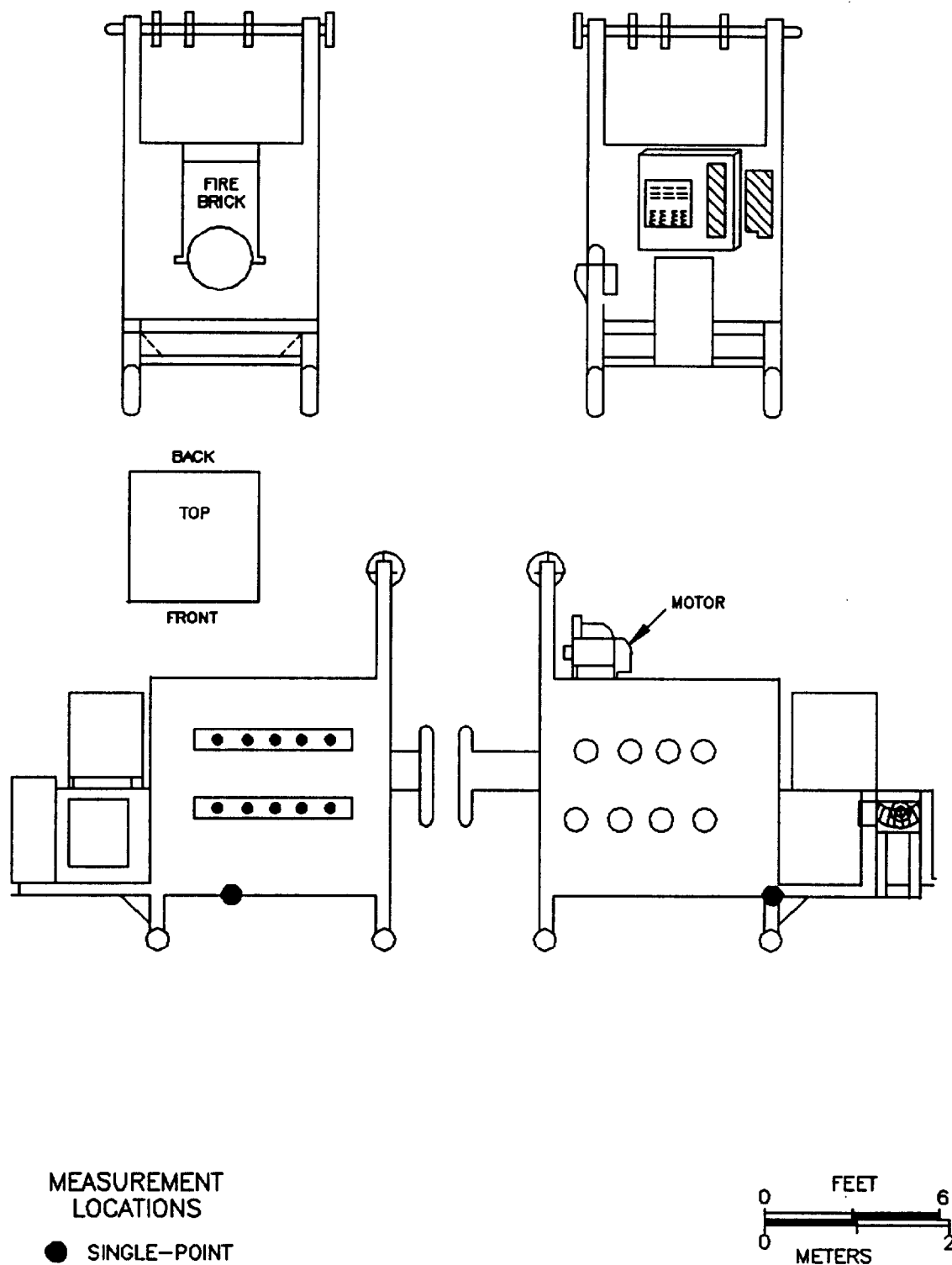


FIGURE 138: Building 30, Fabrication Room, Furnace #38308 – Measurement Locations

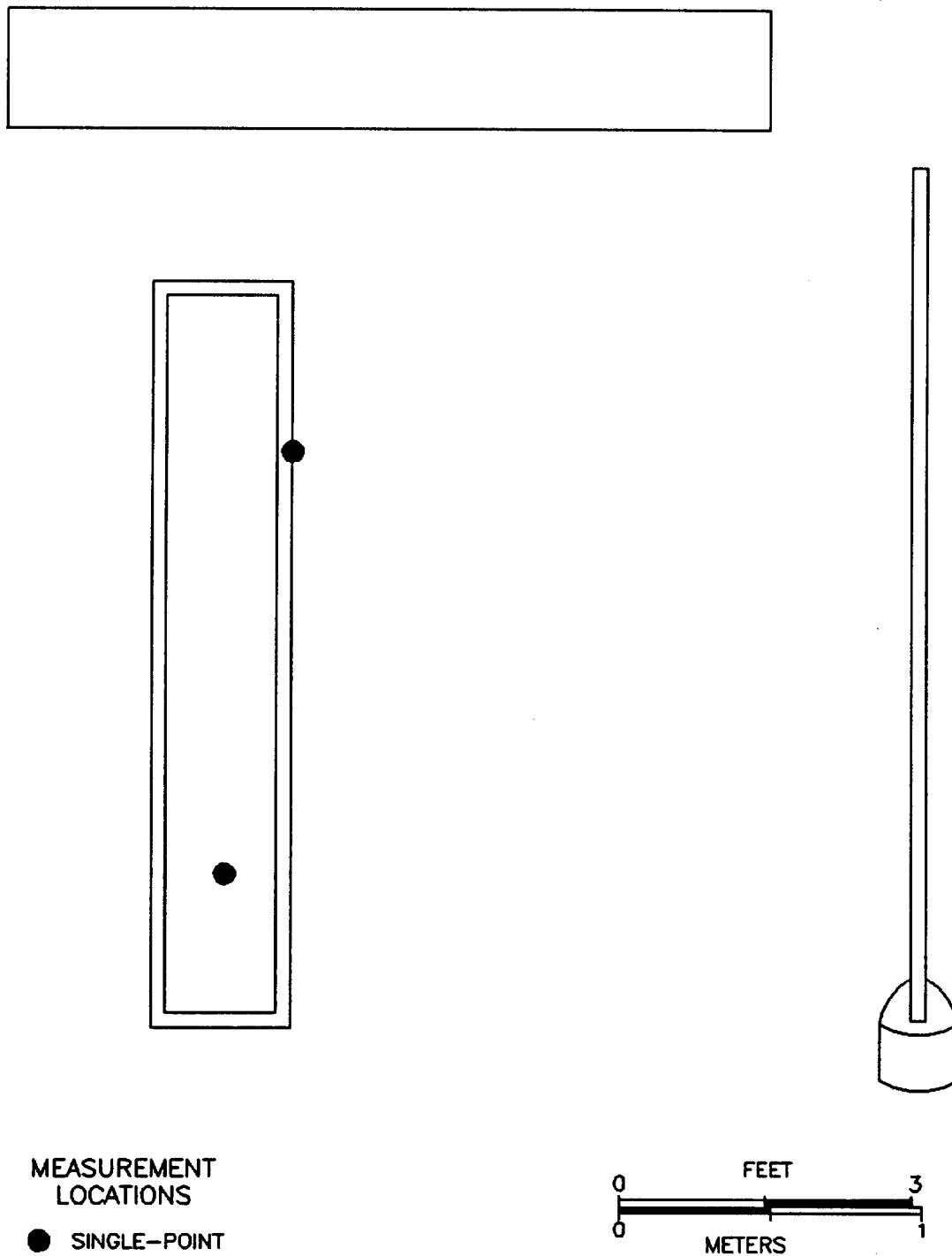


FIGURE 139: Building 30, Fabrication Room Transfer Cart –
Measurement Locations

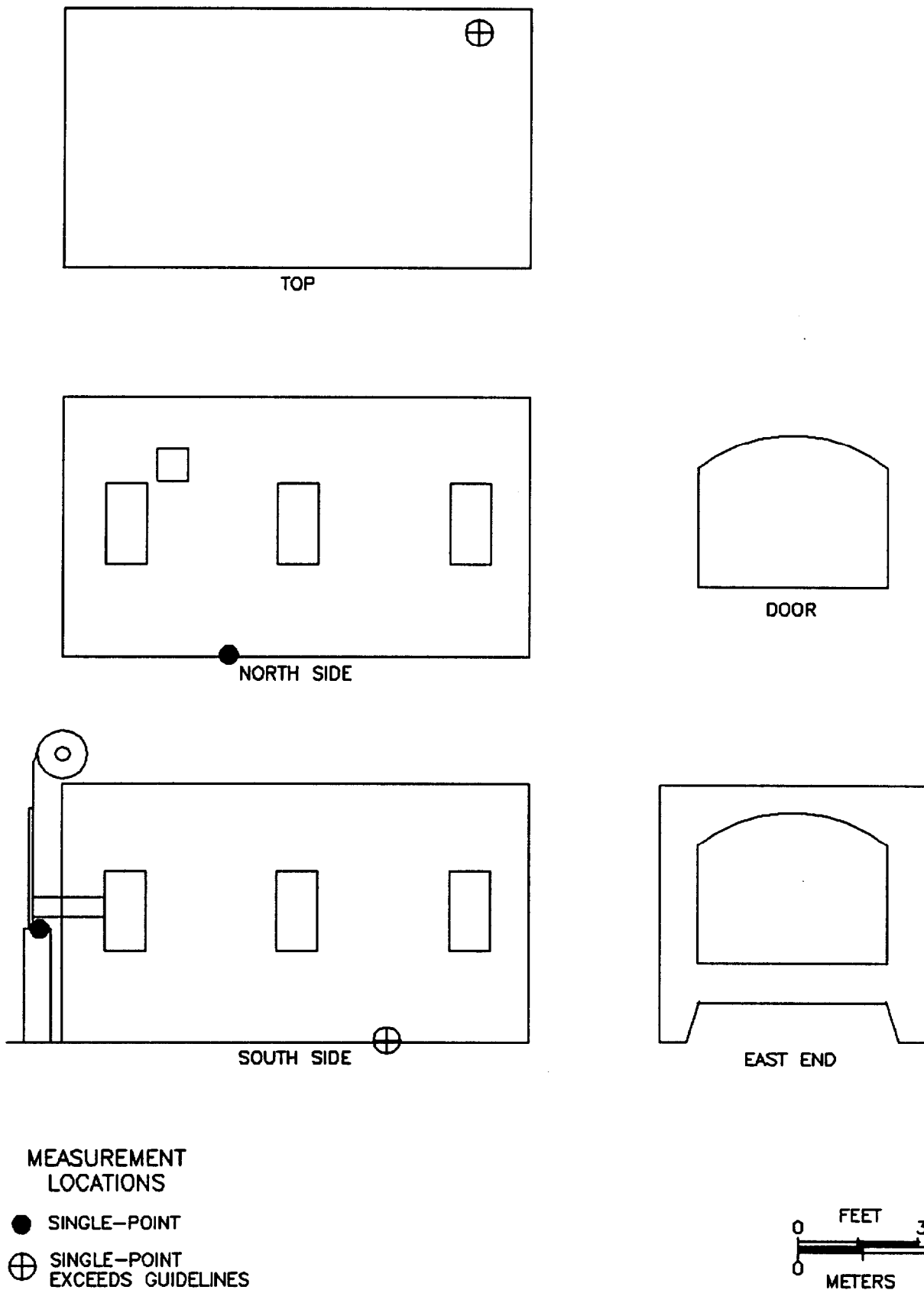


FIGURE 140: Building 30, Fabrication Room, Lindberg Furnace #40424 – Measurement Locations

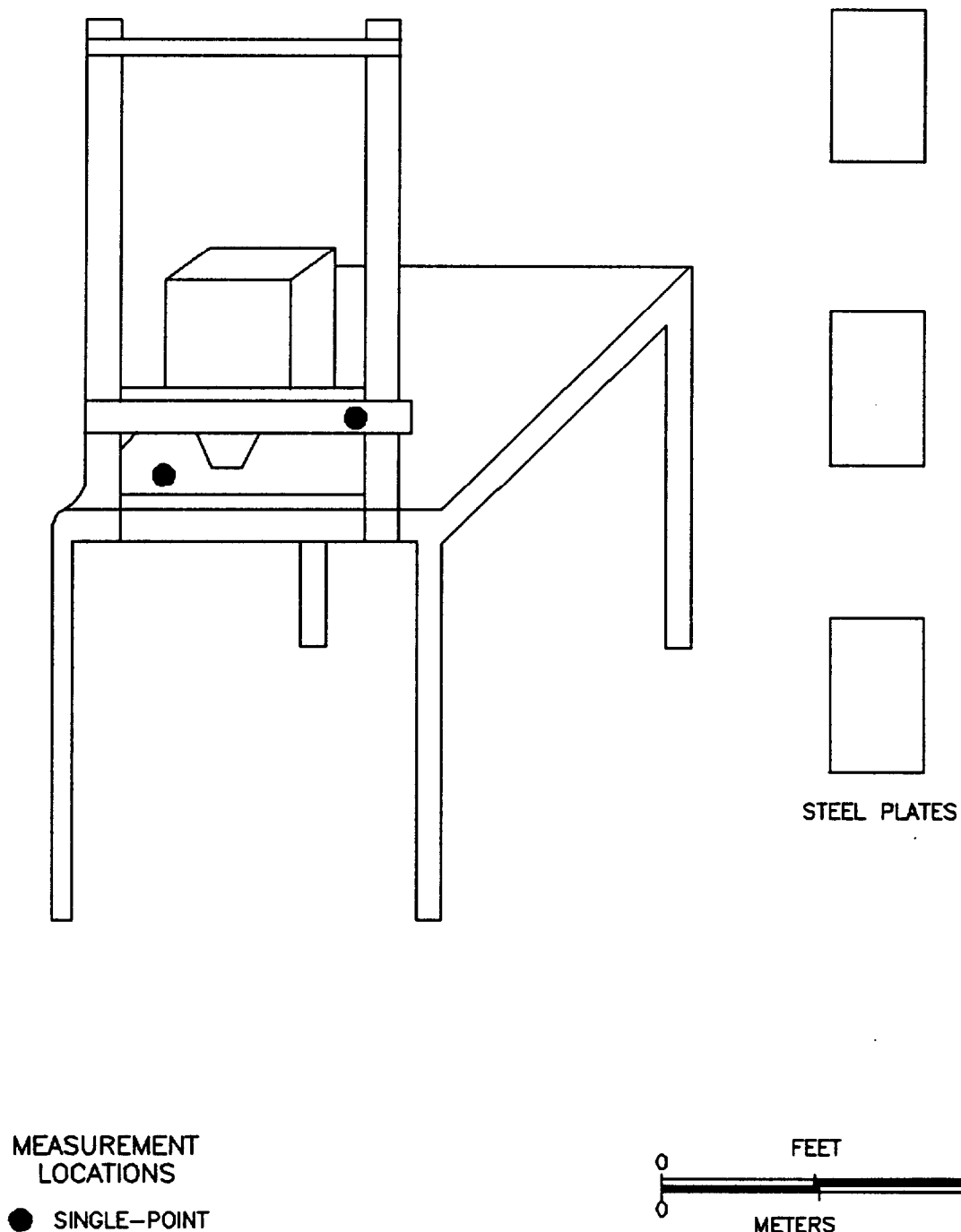
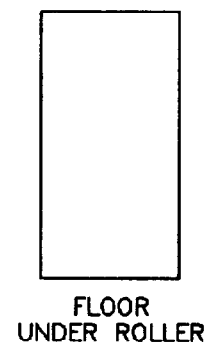
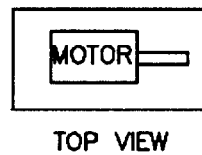
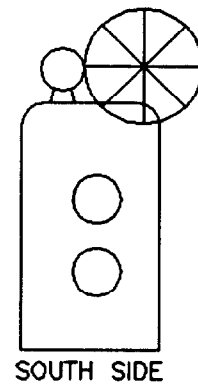
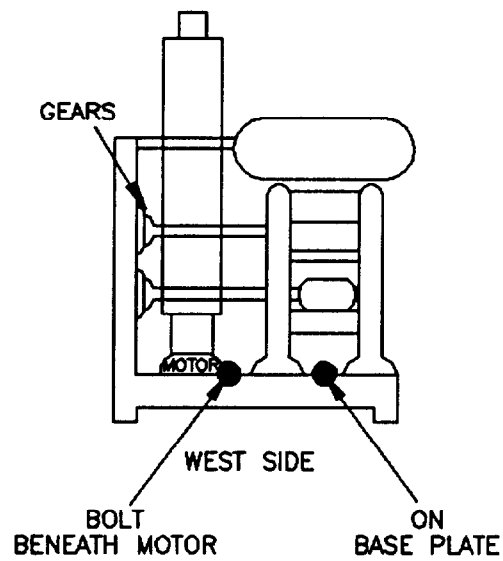


FIGURE 141: Building 30, Fabrication Room, Brinell Hardness Testing Machine #34274 - Measurement Locations



MEASUREMENT
LOCATIONS

● SINGLE-POINT

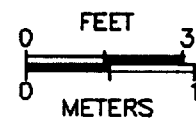
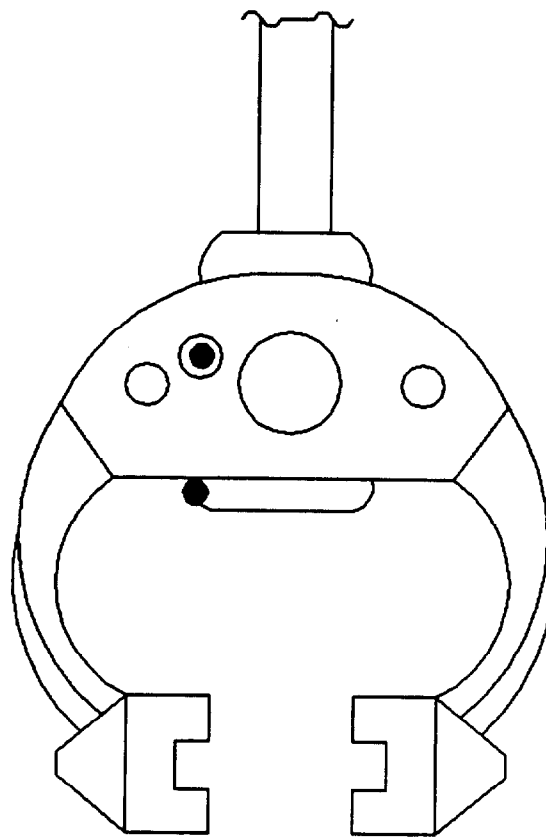
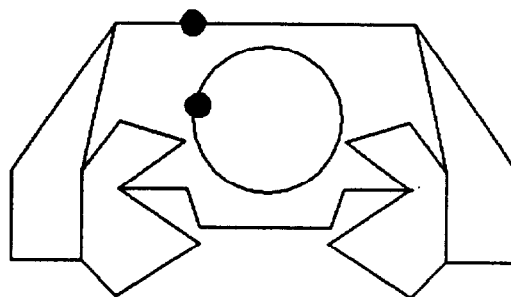


FIGURE 142: Building 30, Fabrication Room, Rolling Mill
#39974 - Measurement Locations



TOP VIEW



FRONT VIEW

MEASUREMENT
LOCATIONS

● SINGLE-POINT

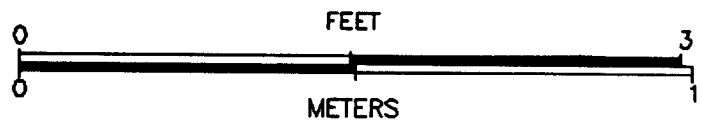


FIGURE 143: Building 30, Fabrication Room, Clark Puller #34679 –
Measurement Locations

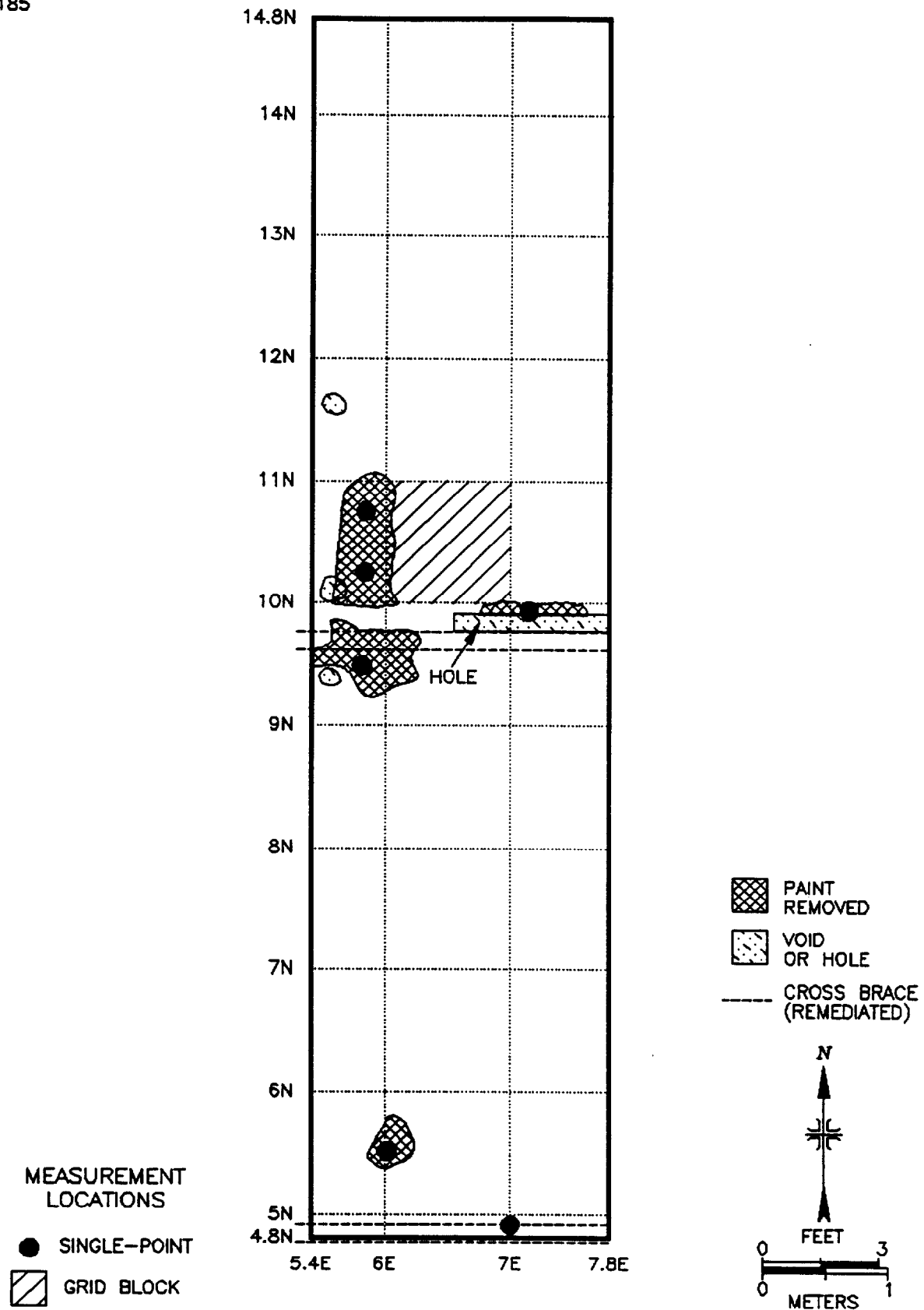


FIGURE 144: Building 30, Fabrication Room, West Mezzanine – Remediated Areas and Measurement and Sampling Locations

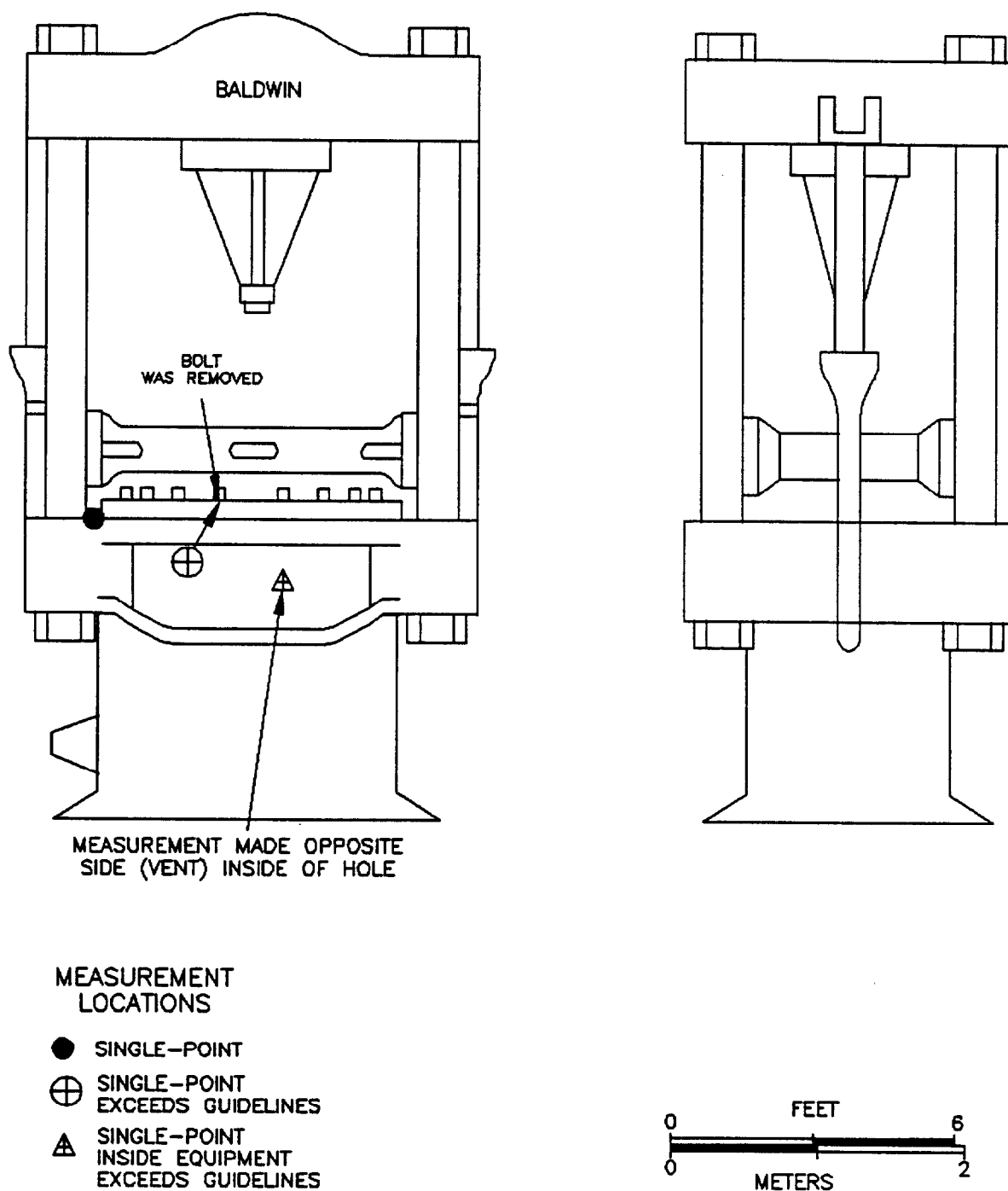


FIGURE 145: Building 30, Machine Shop, Baldwin Press #39768 – Measurement Locations

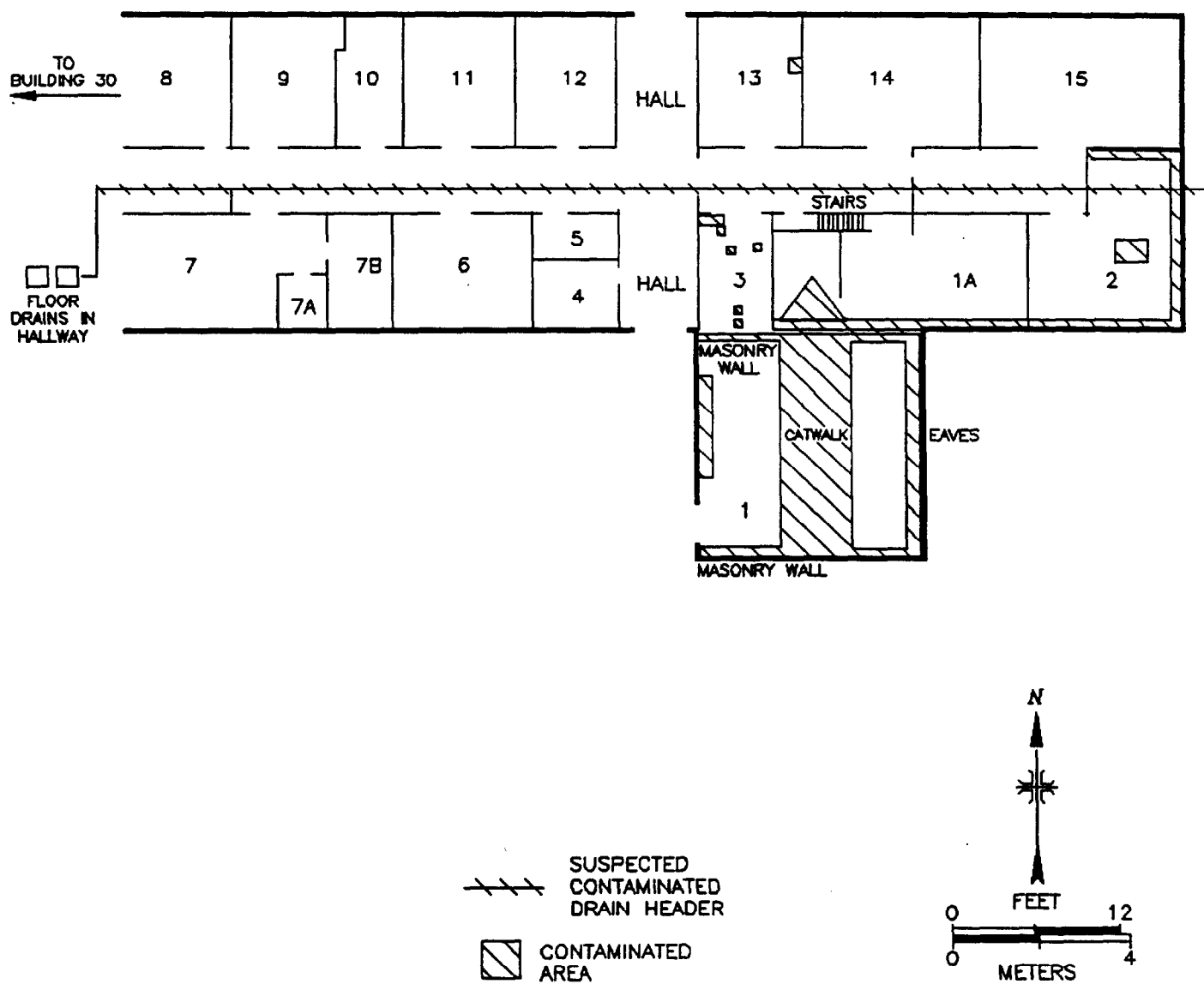


FIGURE 146: Plot Plan of Building 31

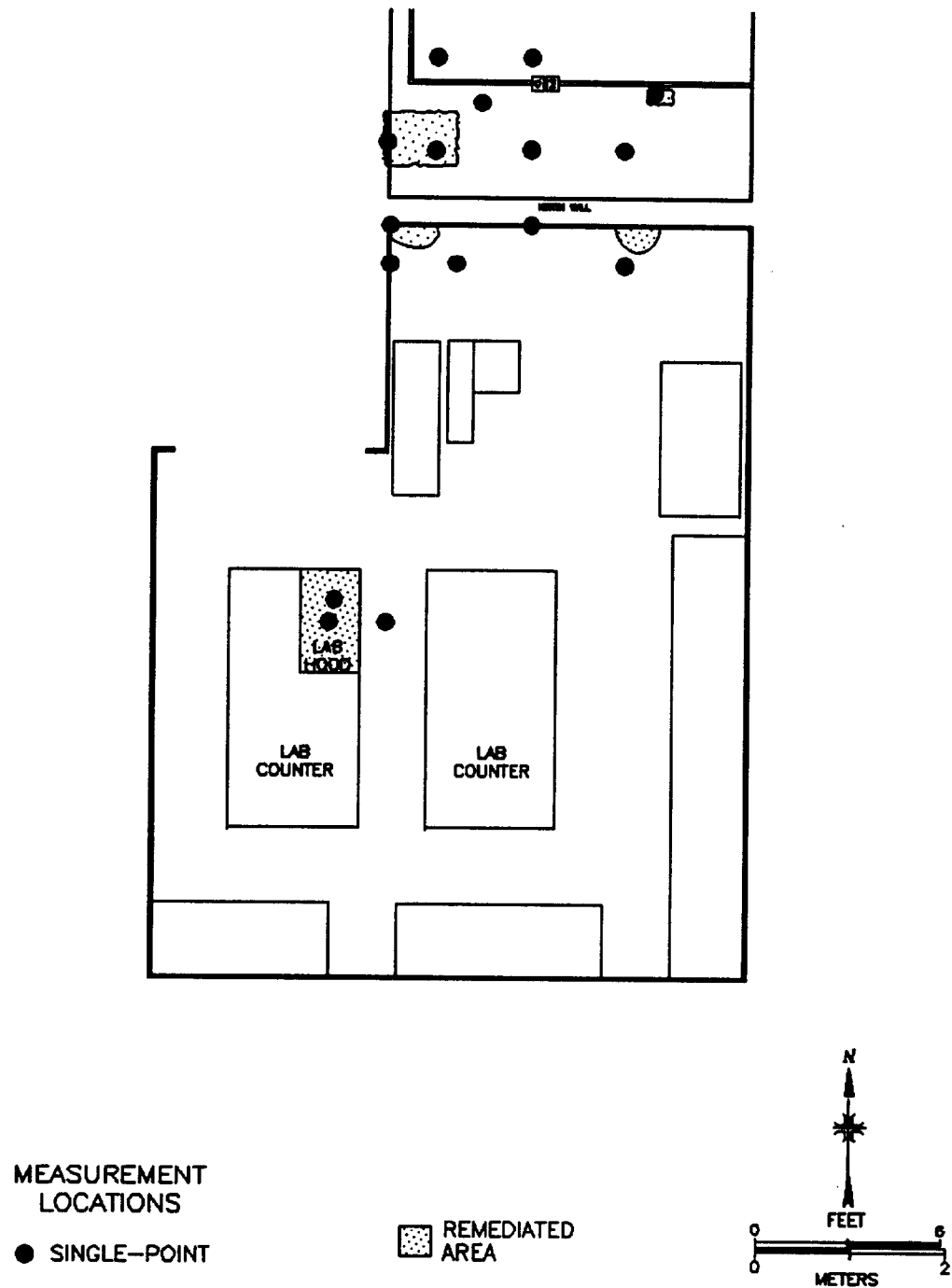


FIGURE 147: Building 31, Room 2 Floor, North Wall, and Counter Space – Remediated Areas and Measurement Locations

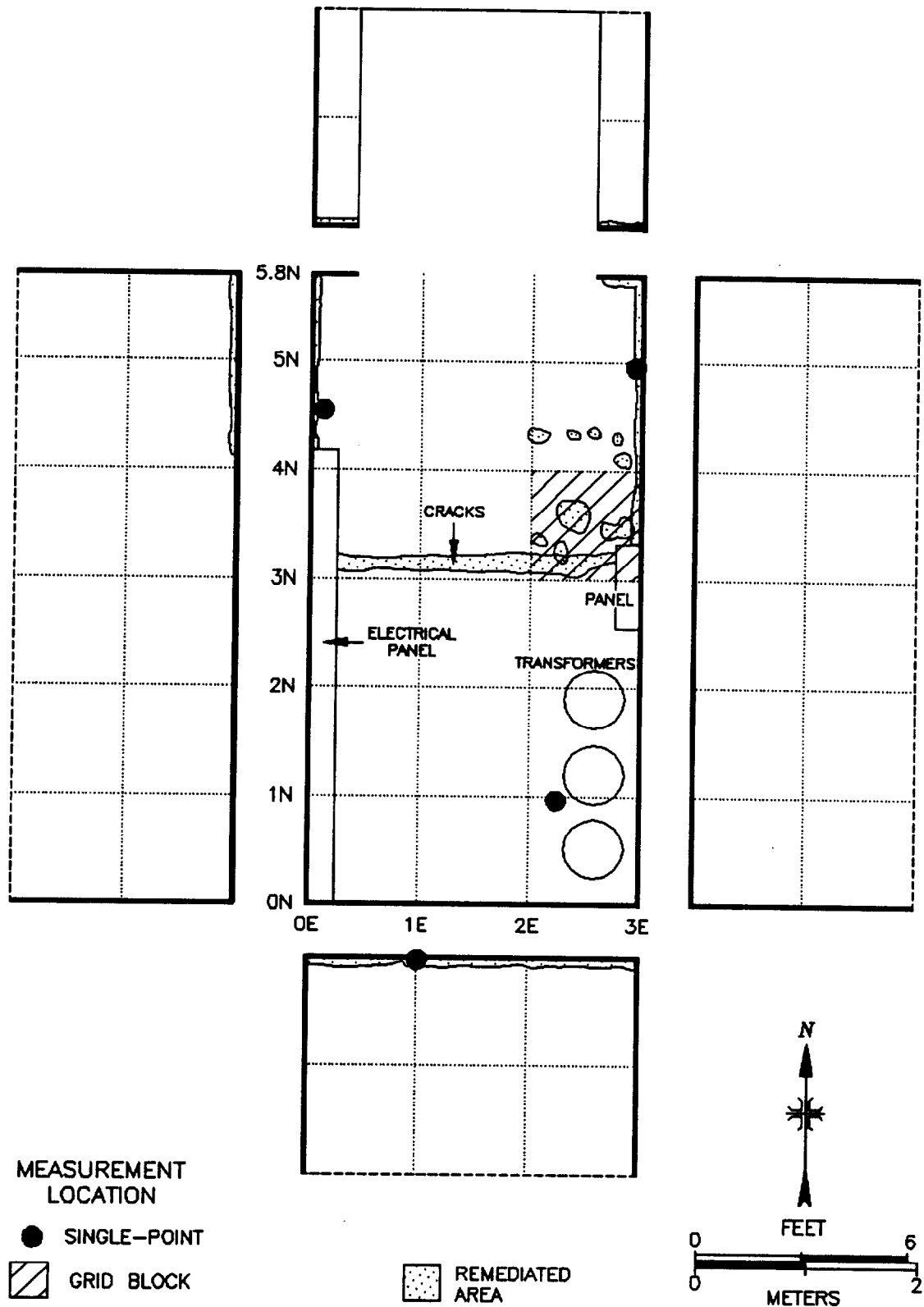


FIGURE 148: Building 31, Electrical Equipment Room #3 – Remediated Areas and Measurement Locations

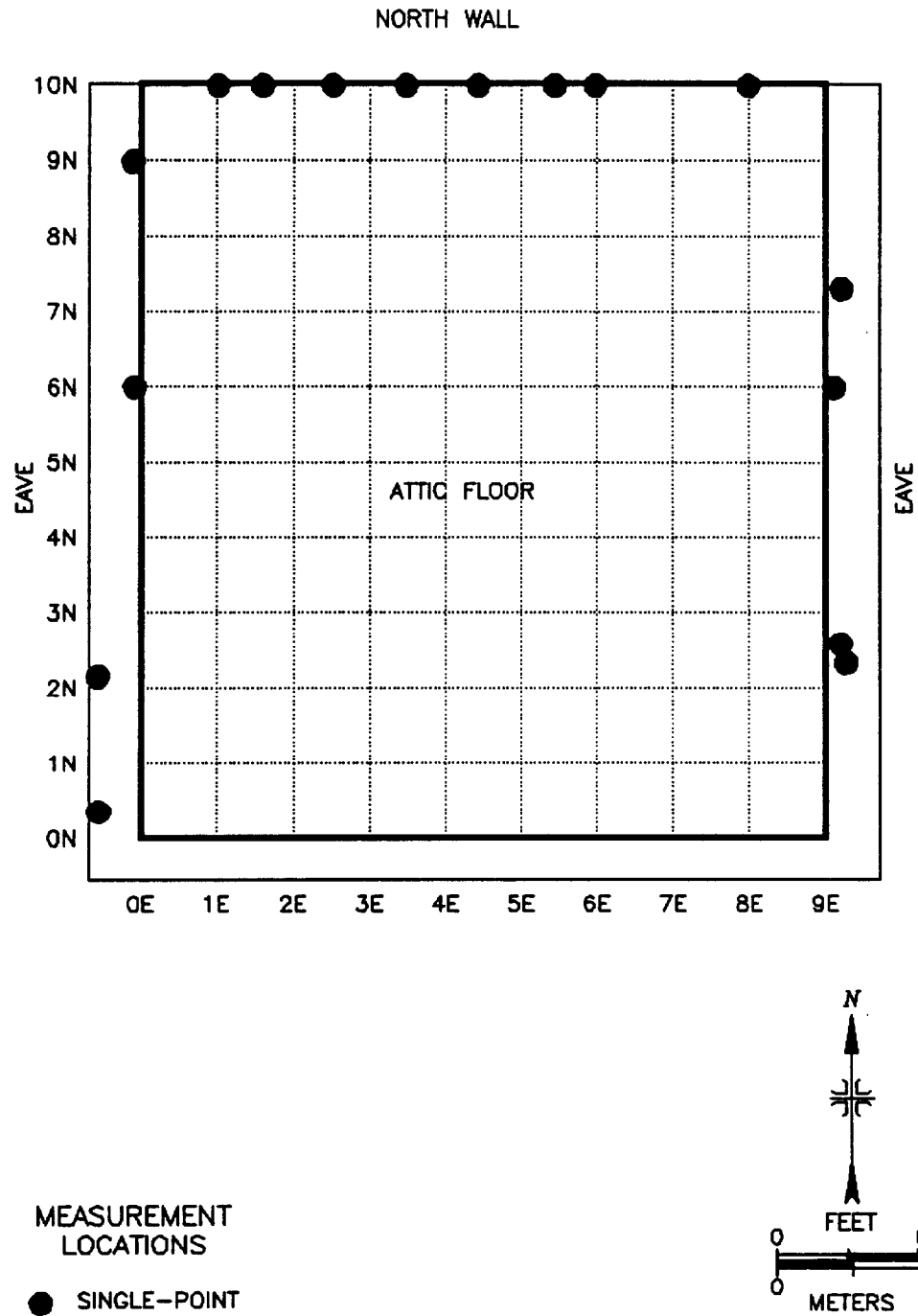


FIGURE 149: Building 31, Eaves of Attic Above Room 1 and Top of North Wall – Measurement Locations

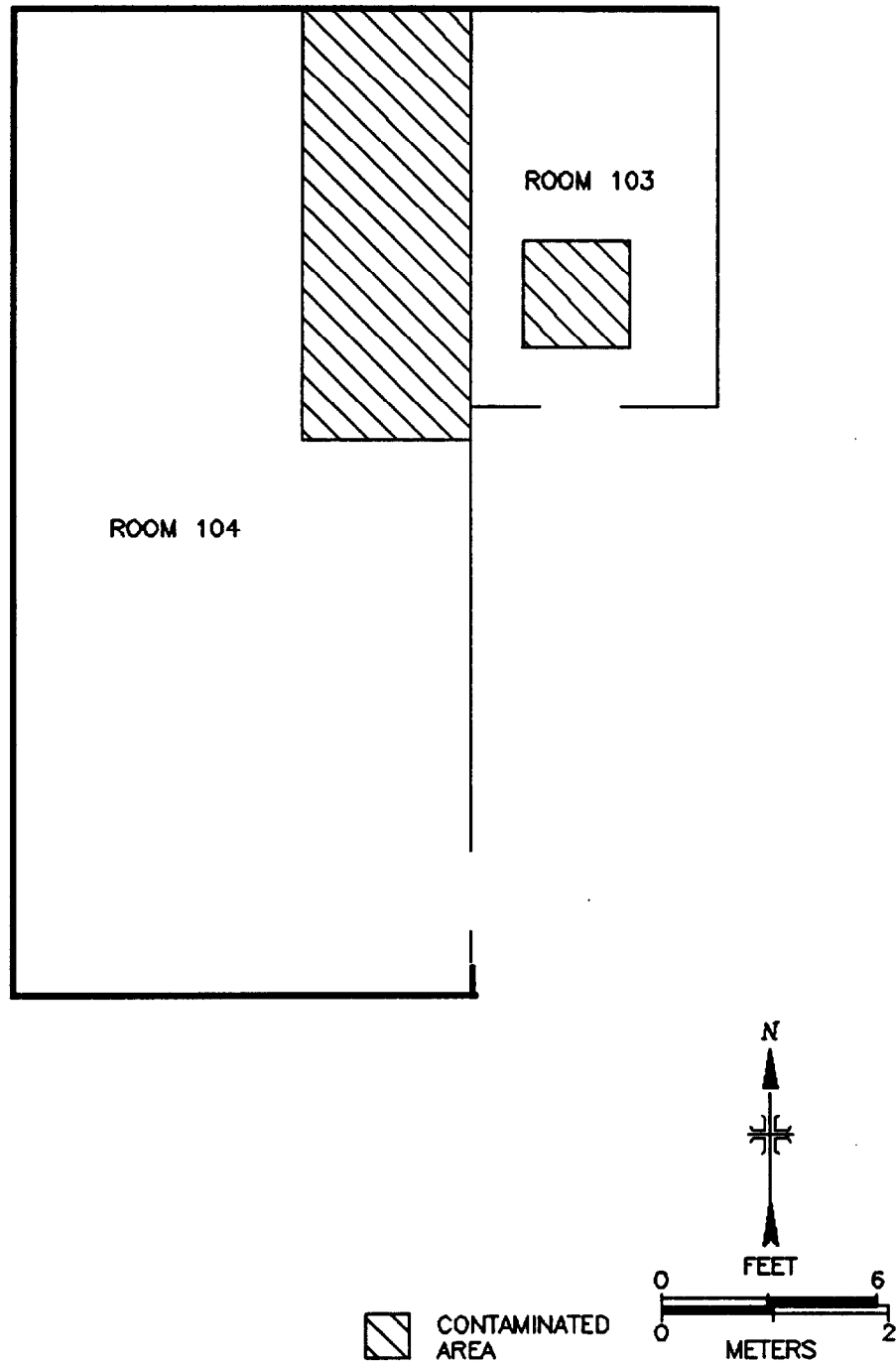


FIGURE 150: Partial Plot Plan of Building 33

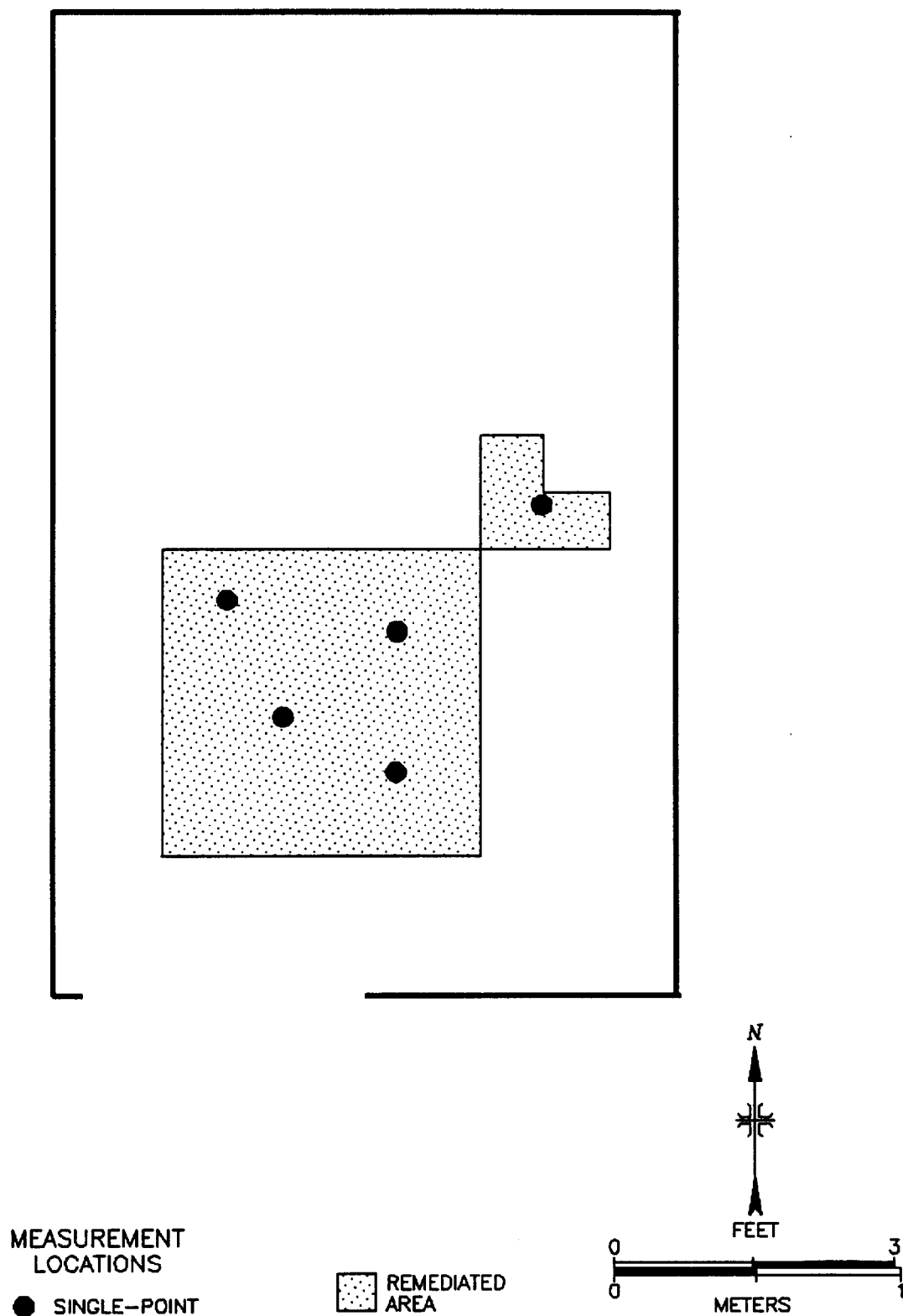


FIGURE 151: Building 33, Room 103 Floor — Remediated Area and Measurement Locations

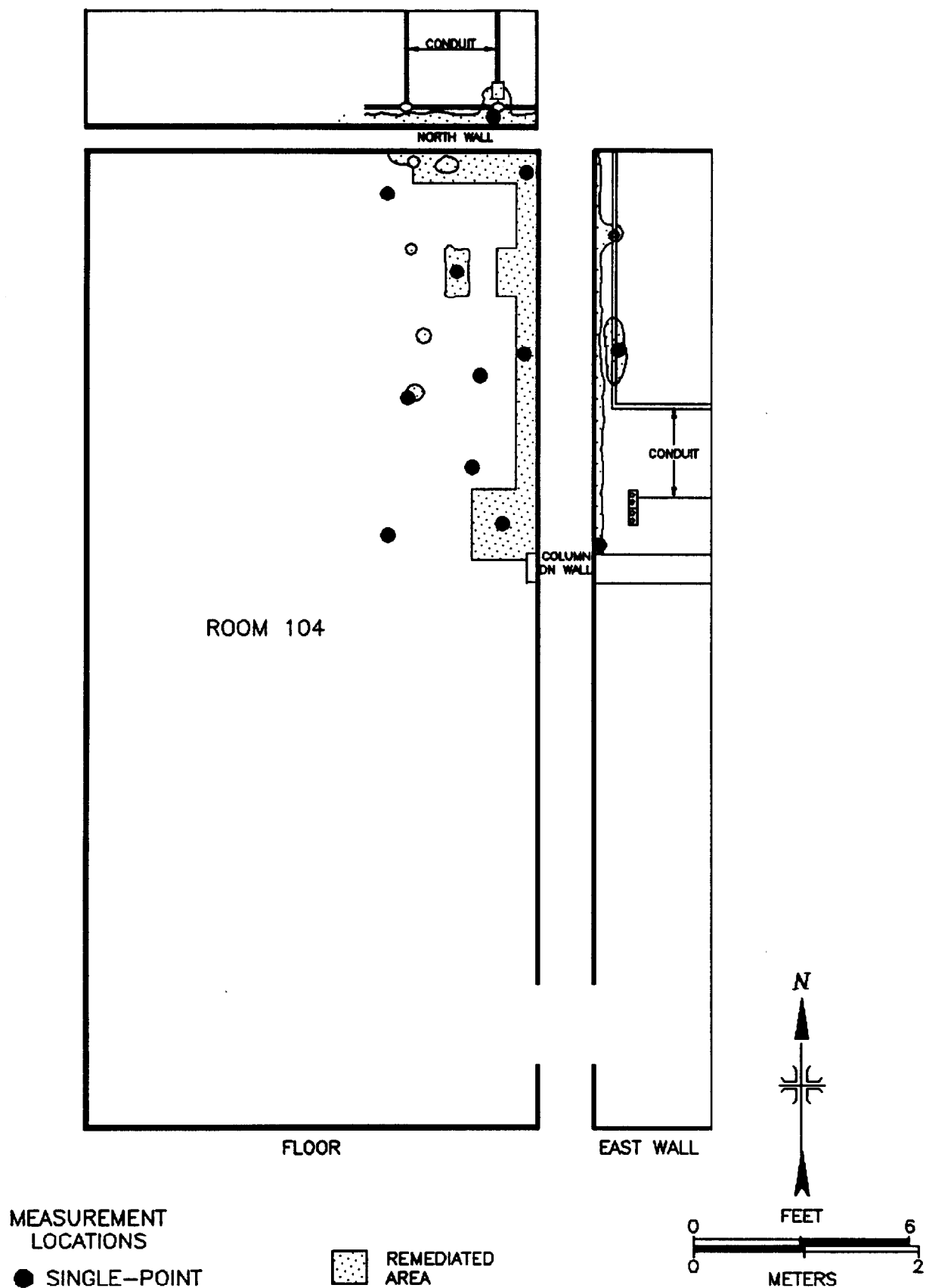


FIGURE 152: Building 33, Room 104 Floor and Wall — Remediated Area and Measurement Locations

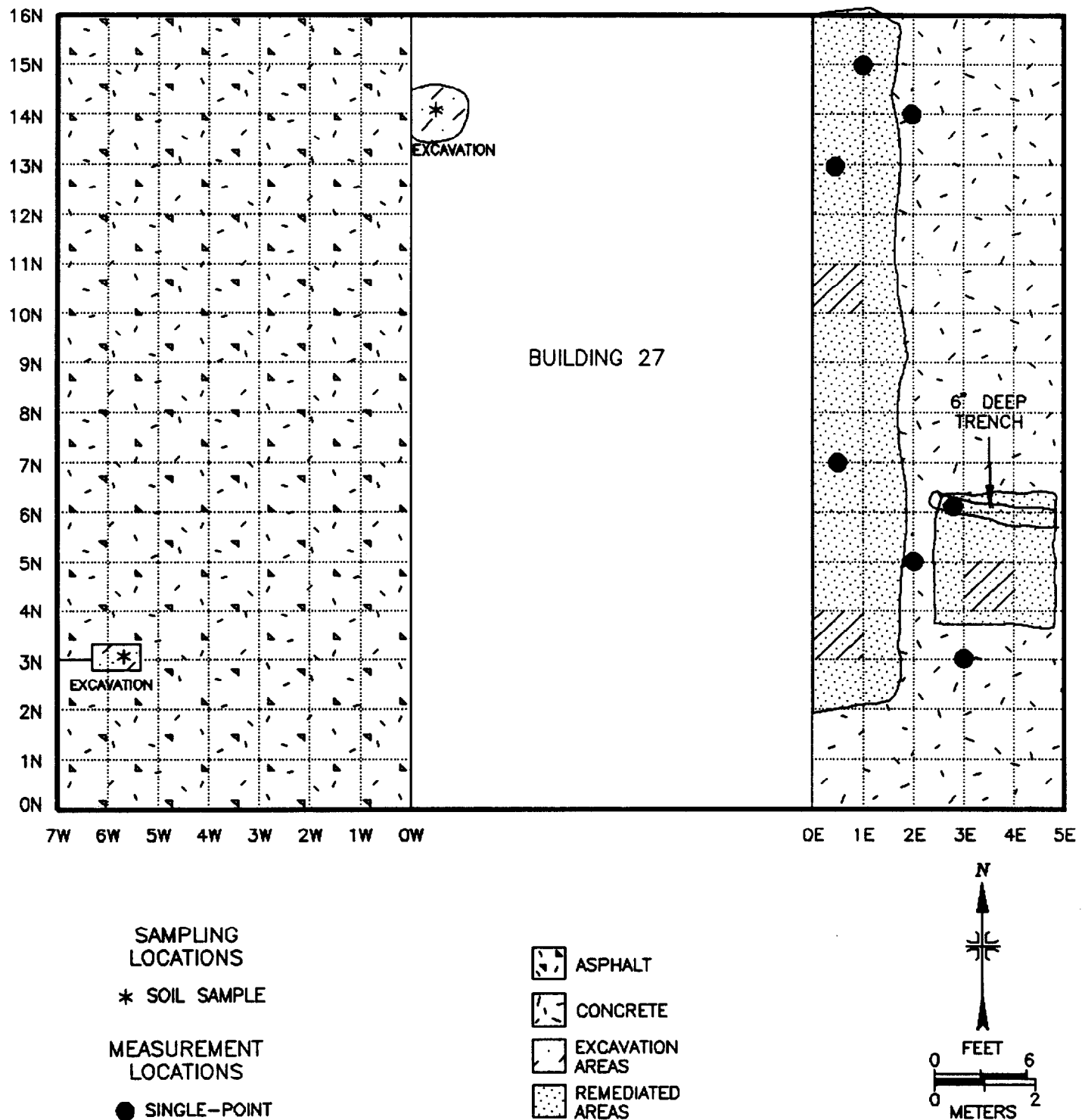


FIGURE 153: Building 27, Exterior – Remediated Areas and Measurement and Sampling Locations

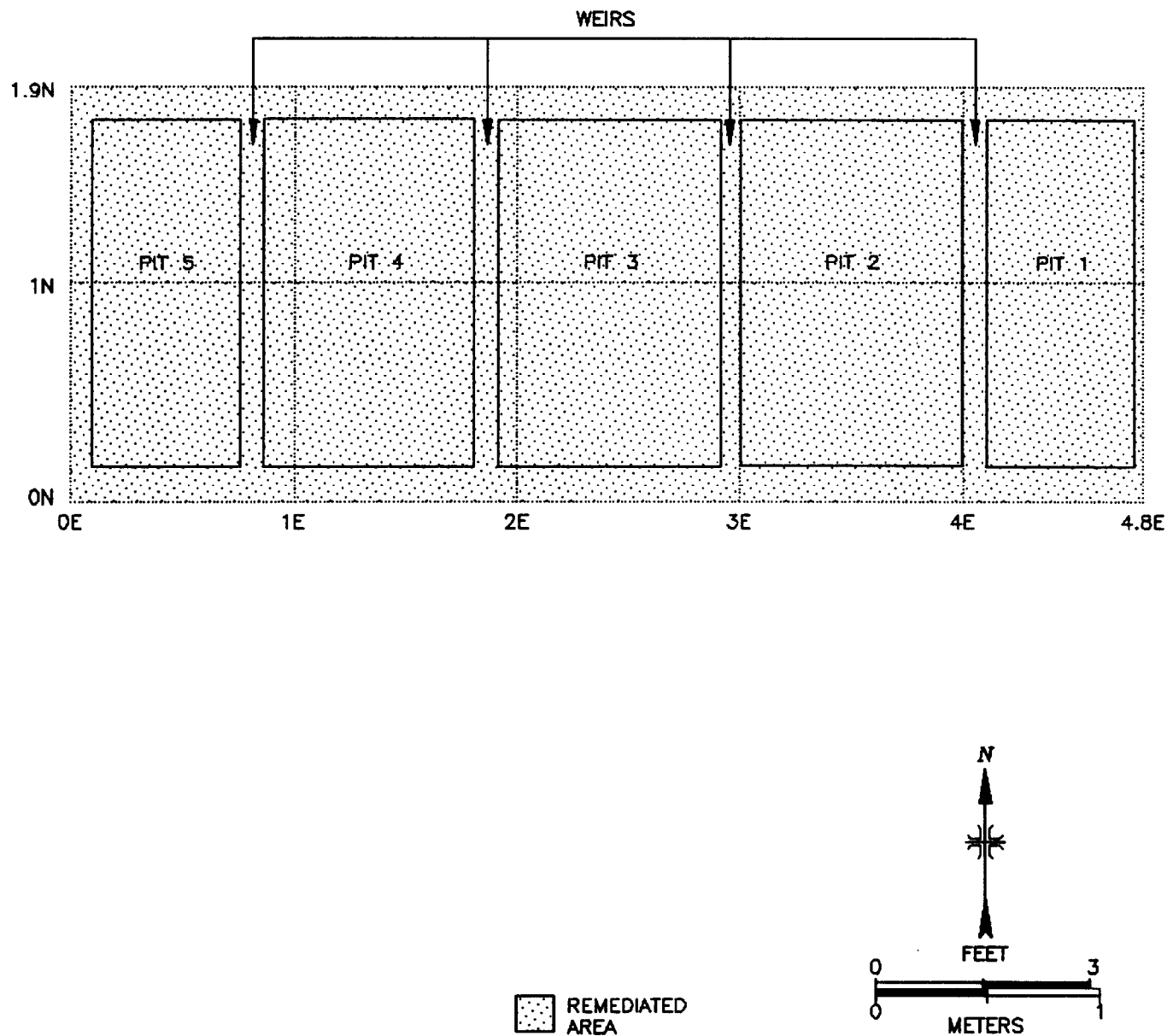


FIGURE 154: Lime Pits Southeast of Building 31 – Remediated Areas

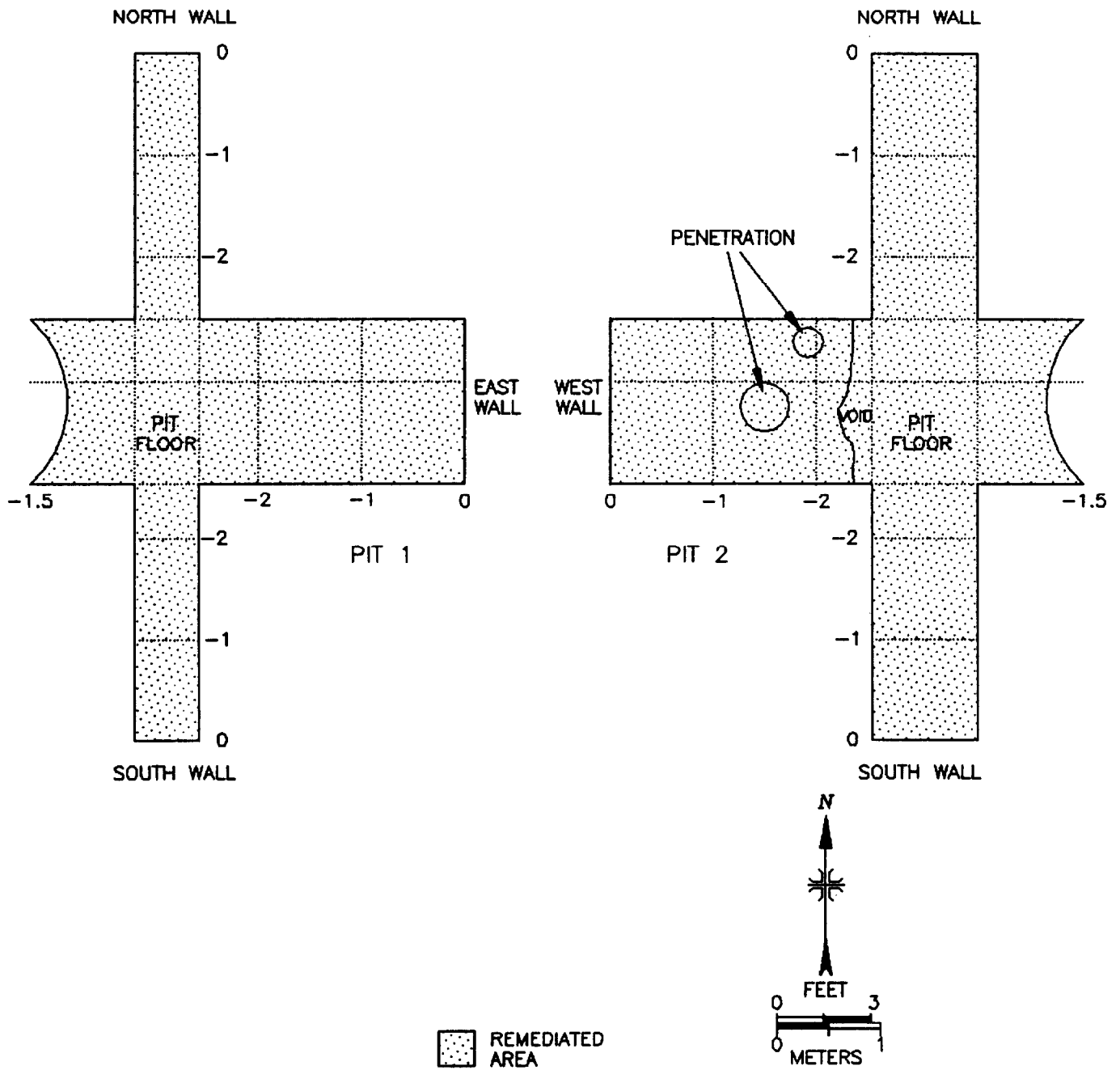


FIGURE 155: Lime Pits #1 and 2 – Remediated Areas

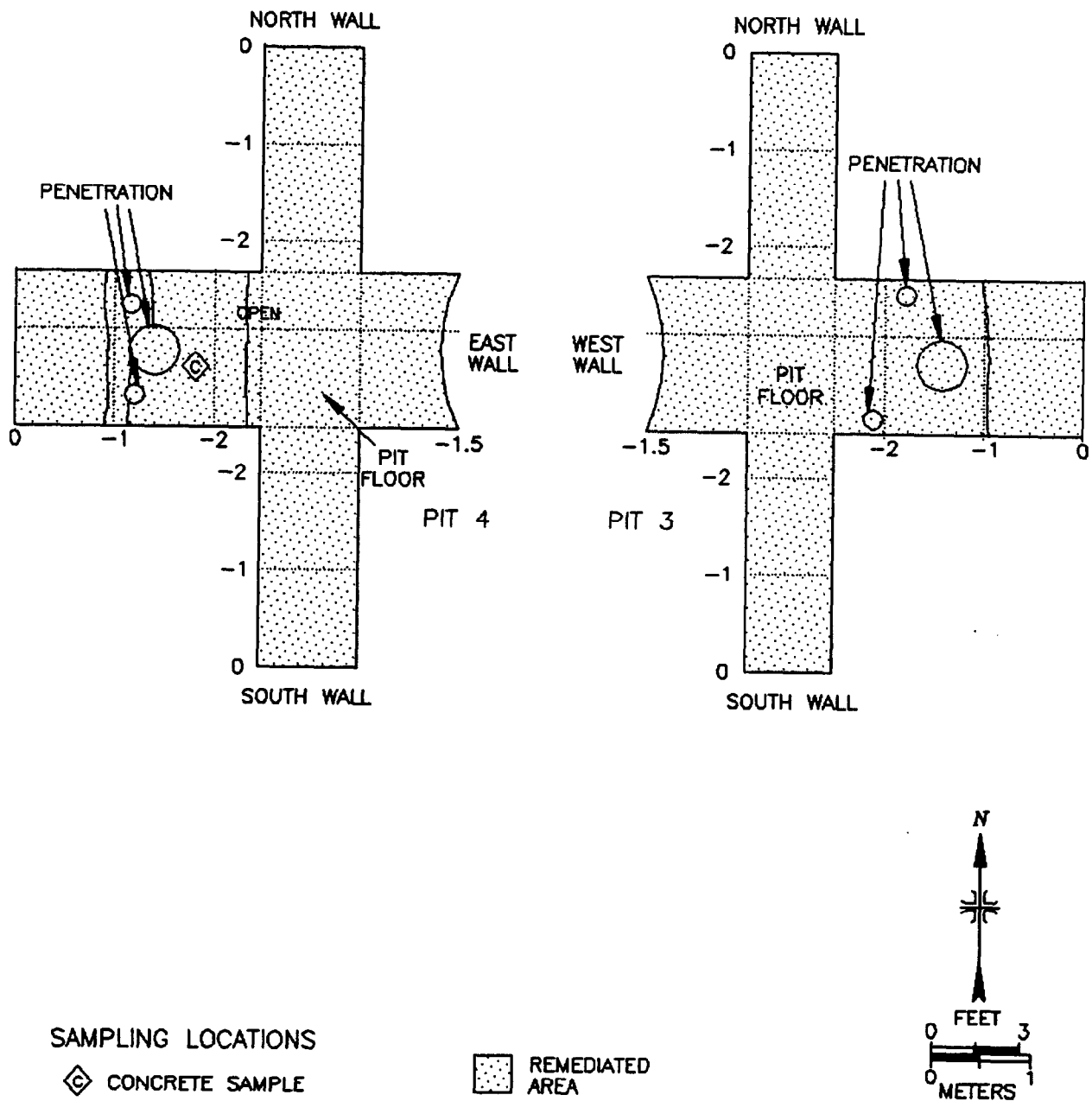
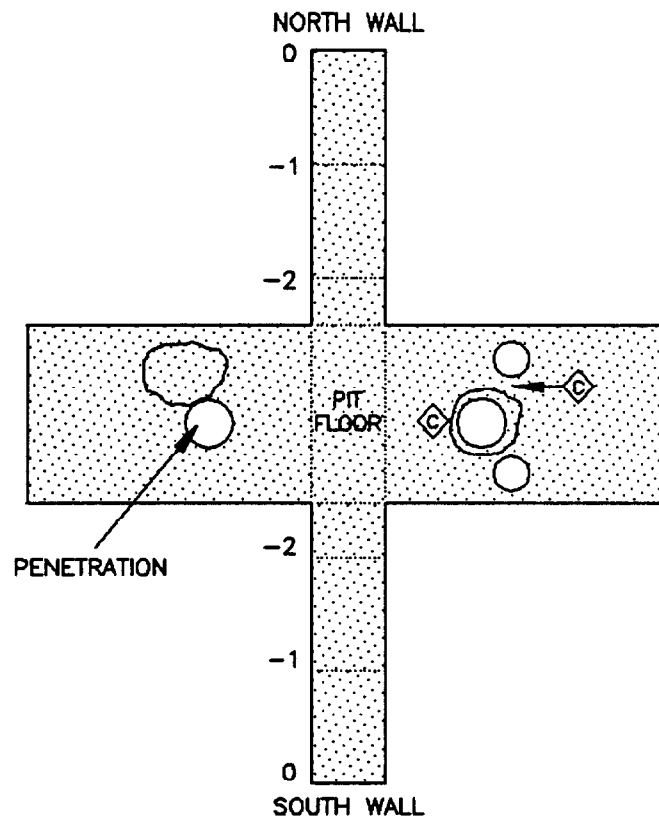


FIGURE 156: Lime Pits #3 and 4 – Remediated Areas and Sampling Locations



SAMPLING LOCATIONS

◇ CONCRETE SAMPLE

REMEDIATED AREAS



FIGURE 157: Lime Pit #5 East of Building 31 – Remediated Areas and Sampling Locations

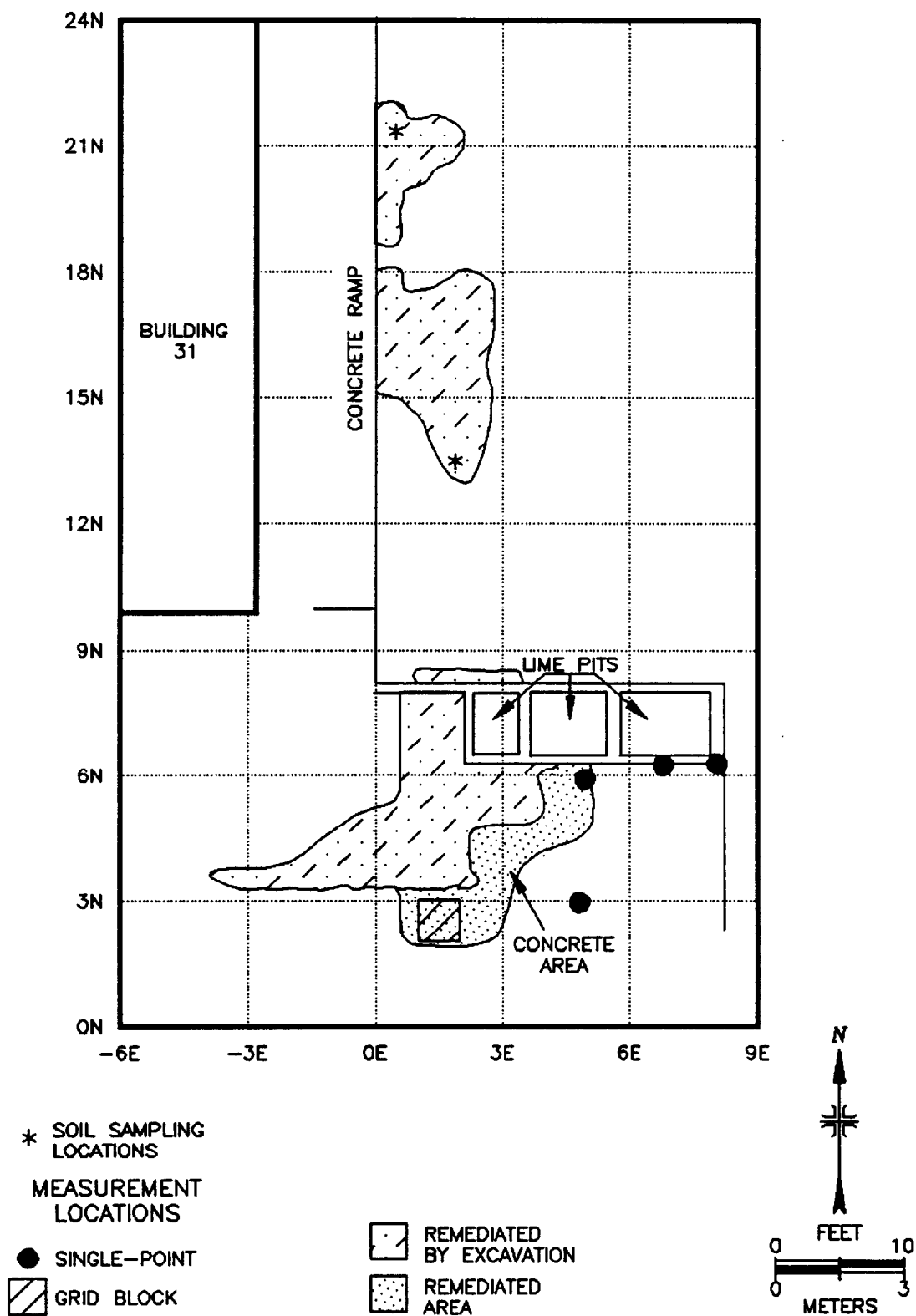


FIGURE 158: Evacuations and Remediated Areas Adjacent to Lime Pit – Measurement and Sampling Locations

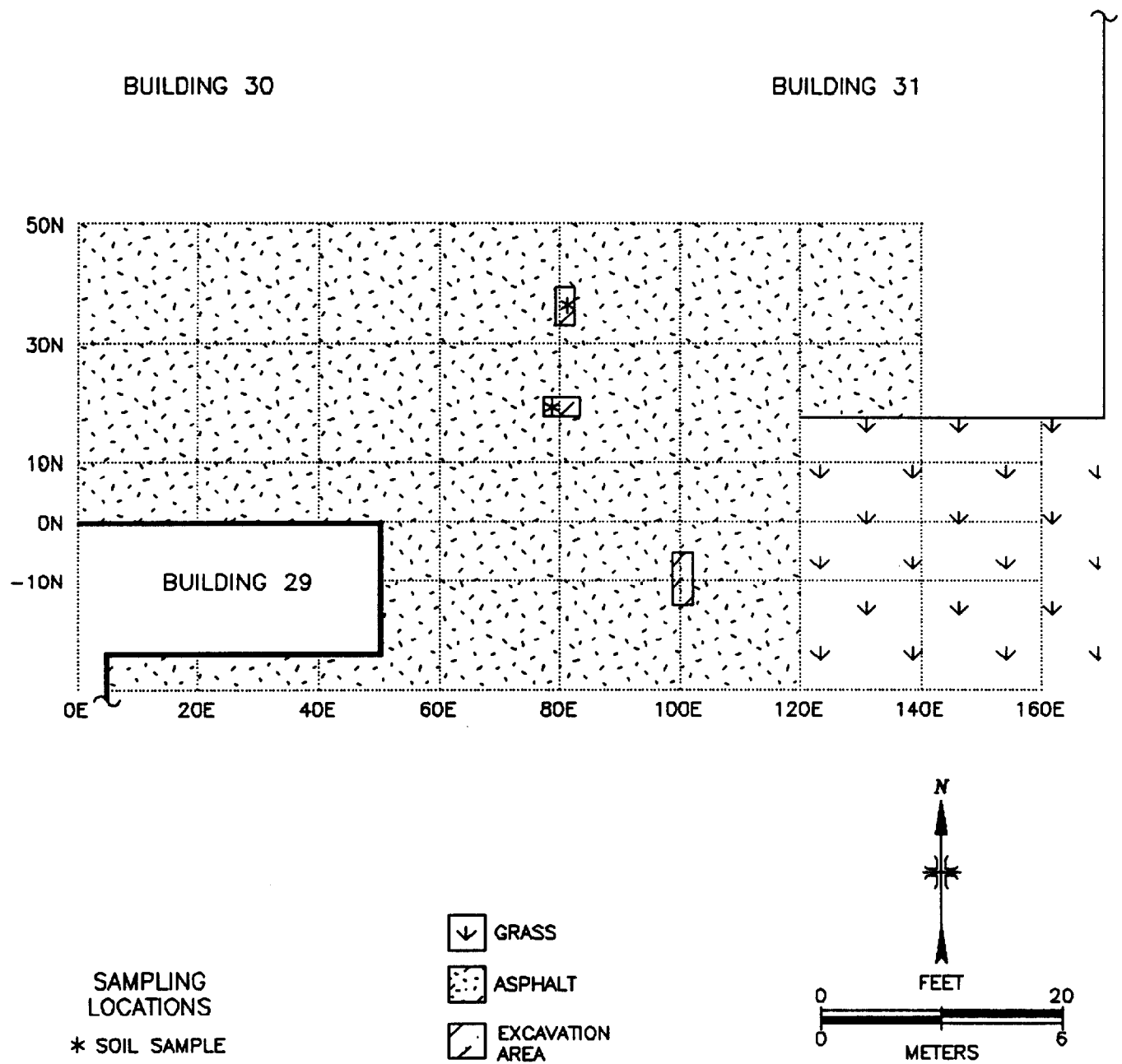


FIGURE 159: Excavations South of Buildings 30/31 – Sampling Locations

TABLE 1

**SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
FOR AREAS WITH TH-232 GUIDELINES OF 1000/3000/200
ALBANY RESEARCH CENTER
ALBANY, OREGON**

Bldg.	Room	Location*	# of Measurement Locations		Highest Grid Block Average (dpm/100 cm ²)		Total Activity (dpm/100 cm ²)		Removable Activity (dpm/100 cm ²)		Meets Guideline?
			Grid Block	Single-Points	α	β	α range	β range	α range	β range	
1	119	Floor	1	4	<110	<850	<110	<850	<6	<13	Yes
		Lower Wall	— ^b	1	<110	<850	<110	<850	<6	<13	Yes
	306	Floor	—	9	N/A ^c	N/A	<110	<850 - 920	<6	<13	Yes
		Lower Wall	—	1	N/A	N/A	<80	<850	<6	<13	Yes
3	101	Floor	—	11	N/A	N/A	<110	<850	<6	<13	Yes
	102	Hydraulic Press #35443	—	8	N/A	N/A	<62 - 220	<410 - 960	<6	<13	Yes
	103	Floor	2	3	<80	450	<110	<410 - 600	<6	<13	Yes
4	103	Trench	1	2	N/A	N/A	<83	<440 - 530	<6	<13	Yes
		Drains	—	4	N/A	N/A	—	<440 - 1,900 ^d	<6	<13	Yes ^d
	105	Trench	—	2	N/A	N/A	<83	<440	<6	<13	Yes
		East Pit	—	4	N/A	N/A	<83 - 340	<440 - 1,500 ^d	<6	<13	Yes ^d
		West Pit	—	4	N/A	N/A	110 - 240	940 - 1,500 ^d	<6	<13	Yes ^d
	106	Pit	—	4	N/A	N/A	<69 - 90	<440 - 850	<6	<13	Yes
		Mezzanine	1	6	<62	<410	<62	<410	<6-7	<13	Yes
	Exterior	Blower Platform South Wall	—	5	N/A	N/A	<62	<410 - 680	<6	<13	Yes
5	Plumbing Shop	Floor	3	9	<69	510	<69	<440 - 970	<6	<13	Yes
		Lower Walls	2	3	<69	<440	<69	<440	<6	<13	Yes
		Upper Walls	—	3	N/A	N/A	<69	<440	<6	<13	Yes

TABLE 1 (Continued)

**SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
FOR AREAS WITH TH-232 GUIDELINES OF 1000/3000/200
ALBANY RESEARCH CENTER
ALBANY, OREGON**

Bldg.	Room	Location*	# of Measurement Locations		Highest Grid Block Average (dpm/100 cm ²)		Total Activity (dpm/100 cm ²)		Removable Activity (dpm/100 cm ²)		Meets Guideline?
			Grid Blocks	Single-Points	α	β	α range	β range	α range	β range	
5	Plumbing Shop	Ceiling	—	3	N/A	N/A	<69	<440	<6	<13	Yes
		Equipment	—	2	N/A	N/A	<69	<440	<6	<13	Yes
		Roof above Plumbing Shop	2	11	88	<440	<69 - 150	<440	<6	<13	Yes
	Machine Shop	Floor	1	16	<62	<410	<62 - 130	<410 - 780	<6	<13	Yes
		South Wall Roof Eave	—	7	N/A	N/A	<83	<440	<6	<13	Yes
		South Wall Conduit	—	4	N/A	N/A	100 - 140	<380 - 2,400 ^d	<6	<13	Yes ^d
		Exterior South Windows	—	10	N/A	N/A	<62 - 220	<410 - 780	<6	<13	Yes
	Exterior	South of Metal Storage Room	—	1	<62	530	<62 - 93	<410 - 740	<6	<13	Yes
17	1st Floor Mens Room	Valve Pit	—	5	N/A	N/A	<62 - 350	<410 - 1,200 ^d	<6	<13	Yes ^d
	Open Storage Area	Floor	3	—	<96	<440	<96	<410 - 560	<6	<13	Yes
		Lower Wall	2	—	<96	<410	<96	<410	<6	<13	Yes
	10-A	Floor	1	9	<83	<440	<83 - 210	<440 - 840	<6	<13	Yes
		Lower Wall	1	3	98	<440	<83 - 140	<440	<6	<13	Yes

TABLE 1 (Continued)

**SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
FOR AREAS WITH TH-232 GUIDELINES OF 1000/3000/200
ALBANY RESEARCH CENTER
ALBANY, OREGON**

Bldg.	Room	Location*	# of Measurement Locations		Highest Grid Block Average (dpm/100 cm ²)		Total Activity (dpm/100 cm ²)		Removable Activity (dpm/100 cm ²)		Meets Guidelines?
			Grid Blocks	Single-Points	α	β	α range	β range	α range	β range	
17	Exterior	Sidewalk East of Lab 10	1	2	110	950	<62 - 250	<890 - 1,600	<6	<13	Yes
23	Basement	Floor	7	17	<110	470	<110 - 120	<440 - 1,100	<6	<13	Yes
		Lower Walls	6	10	<110	<440	<110 - 140	<440	<6	<13	Yes
		Upper Walls and Ceilings	—	8	N/A ⁴	N/A	<110	<440	<6	<13	Yes
		Tunnel	—	10	N/A	N/A	<110	<350 - 770	<6	<13	Yes
		Sump Pump	Area Surface Scanned and BNI Data Reviewed.								Yes
		Elevator Shaft Floor	—	10	N/A	N/A	<110	<350 - 670	<6	<13	Yes
		Elevator Shaft Lower Wall	2	2	<110	500	<110	<440 - 700	<6	<13	Yes
	Southwest Stairwell	Floor	—	4	N/A	N/A	<83	<440	—	—	Yes
		Lower Wall	—	4	N/A	N/A	<83	<440	—	—	Yes
		Conical Mill Equipment #38562	—	5	N/A	N/A	N/A	<380 - 6,200	<6 - 15	<13 - 15	No Accepted by ARC
		Vent Pipe	—	1	N/A	N/A	N/A	10,000	200	110	No Accepted by ARC
		Braun Pulverizer #39514	—	2	N/A	N/A	<69 - 120	<444 - 620	<6	<13	Yes
		Equipment #38834	—	1	N/A	N/A	<110	490	—	—	Yes

TABLE 1 (Continued)

**SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
FOR AREAS WITH TH-232 GUIDELINES OF 1000/3000/200
ALBANY RESEARCH CENTER
ALBANY, OREGON**

Bldg.	Room	Location*	# of Measurement Locations		Highest Grid Block Average (dpm/100 cm ²)		Total Activity (dpm/100 cm ²)		Removable Activity (dpm/100 cm ²)		Meets Guideline?
			Grid-Blocks	Single-Points	α	β	α range	β range	α range	β range	
23	Exterior	East Wall Outside Crusher Room	2	—	<110	710	<110	<440 - 2,400	<6	<13	Yes
		Roof Vent Exit	—	4	N/A	N/A	<83 - 120	<350	—	—	Yes
	Thorium	Floor	1	13	<62	750	<83	<410 - 970	<6	<13	Yes
		Lower Wall	3	10	<83	990	<83	<410 - 1,200	<6	<13	Yes
		Upper Walls and Ceiling	2	11	64	960	<62 - 93	<410 - 1,000	<6	<13	Yes
	Lab 1	NE Corner Floor	1	3	<83	630	<83	<440 - 780	<6	<13	Yes
		NE Corner Lower Wall	—	1	<83	<440	<83	<440	<6	<13	Yes
		Trench #1	—	4	N/A	N/A	<69	<440 - 1,600	<6	<13	No - H/A*
		Trench #2	—	4	N/A	N/A	<69	<440 - 1,400	<6	<13	No - H/A
		Trench #3	—	6	N/A	N/A	<69	<440 - 560	<6	<13	Yes
		Trench #4	—	4	N/A	N/A	<69	<410	<6	<13	Yes
		Trench #5	—	5	N/A	N/A	<69	<410	<6	<13	Yes
		Trench #6	—	9	N/A	N/A	<83	<350 - 1,300 ^d	<6	<13	Yes ^d
		Trench #7	—	10	N/A	N/A	<83	<440 - 1,900 ^d	<6	<13	Yes ^d
		Pipe Into Trench #7	—	1	N/A	N/A	—	11,000	—	—	No - H/A

TABLE 1 (Continued)

**SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
FOR AREAS WITH TH-232 GUIDELINES OF 1000/3000/200
ALBANY RESEARCH CENTER
ALBANY, OREGON**

Bldg.	Room	Location*	# of Measurement Locations		Highest Grid Block Average (dpm/100 cm ²)		Total Activity (dpm/100 cm ²)		Removable Activity (dpm/100 cm ²)		Meets Guideline?
			Grid Blocks	Single-Points	α	β	α range	β range	α range	β range	
23	Lab 1	Trench #8	—	1	N/A	N/A	<83	<440	—	—	Yes
		Trench #9	—	18	N/A	N/A	<83	<440 - 570	<6	<13	Yes
		Furnace Pit	—	3	N/A	N/A	<83	<440 - 690	<6	<13	Yes
		Trench #10	—	7	N/A	N/A	<83	<440 - 690	<6	<13	Yes
		Trench #11	—	3	N/A	N/A	<83	<440 - 730	<6	<13	Yes
		Trench #12	—	11	N/A	N/A	<83	<440 - 650	<6	<13	Yes
		Trench #13	—	14	N/A	N/A	<83	<440 - 1,600 ^d	<6	<13	Yes ^d
		Trench #15	1	10	<83	590	<83	<440 - 640	<6	<13	Yes
		Trench #14	Area Surface Scanned and BNI Data Reviewed.								Yes
		Trench #16	—	5	N/A	N/A	<83	<440 - 1,100	<6	<13	Yes
		Trench #17	2	6	98	800	<69 - 150	<440 - 1,800	<6	<13	Yes
		Trench #18	—	10	N/A	N/A	<62 - 299	<410 - 2,300	<6	<13	No - H/A
		Trench #19	—	4	N/A	N/A	<62	560 - 900	<6	<13	Yes
		Valve Pit	—	2	N/A	N/A	<69	<440	<6	<13	Yes
		West Wall Window	—	6	N/A	N/A	<83	<440-790	<6	<13	Yes
		Floor Adjacent to North Wall	1	6	<83	560	<83	<440-1,000	<6	<13	Yes
		Lower North Wall	—	10	N/A	N/A	<83	<440-920	<6	<13	Yes
		Upper North Wall	1	14	<62	<570	<83- 90	<570-2,400 ^d	<6	<13	Yes ^d
		North Wall Blower	—	2	N/A	N/A	<83	<440	<6	<13	Yes

TABLE 1 (Continued)

**SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
FOR AREAS WITH TH-232 GUIDELINES OF 1000/3000/200
ALBANY RESEARCH CENTER
ALBANY, OREGON**

Bldg.	Room	Location*	# of Measurement Locations		Highest Grid Block Average (dpm/100 cm ²)		Total Activity (dpm/100 cm ²)		Removable Activity (dpm/100 cm ²)		Meets Guideline?
			Grid Blocks	Single-Points	α	β	α range	β range	α range	β range	
23	Lab 1	Floor North of Thorium Room	1	5	<83	470	<83	<440-520	<6	<13	Yes
		Blower Outside East Wall of Thorium Room	---	3	N/A	N/A	<83	<440	<6	<13	Yes
	2nd Floor Crusher	Floor	---	4	N/A	N/A	<80- 90	<410-540	<6	<13	Yes
		Inside Oven	---	2	N/A	N/A	<80	<410	<6	<13	Yes
	2nd Floor Storage	Floor	2	8	<110	<440	<110-110	<440-740	<6	<13	Yes
		Lower Walls	1	5	<110	<440	<110	<440-820	<6	<13	Yes
		Upper Walls and Ceiling	1	8	110	830	<110-150	<440-1,900	<6	<13	Yes
24	103	Floor	2		<110	<850	<110	<850	<6	<13	Yes
		West, Middle & East Trench	---	21	N/A	N/A	<110 - 440	<850	<6	<13	Yes
		Metal Plate Trench Door	---	1	N/A	N/A	<110	<850	<6	<13	Yes
		Conduit Trench	---	1	N/A	N/A	<110	<850	<6	<13	Yes
		Lower Wall	1	---	<110	<850	<110	<850	<6	<13	Yes
	104	Floor	1	---	<110	<850	<110	<850	<6	<13	Yes
	106	Floor	4	6	<110	480	<110 - 130	<410 - 620	<6	<13	Yes
		Lower Walls	3	---	<110	<410	<110	<410	<6	<13	Yes

TABLE 1 (Continued)

**SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
FOR AREAS WITH TH-232 GUIDELINES OF 1000/3000/200
ALBANY RESEARCH CENTER
ALBANY, OREGON**

Bldg.	Room	Location*	# of Measurement Locations		Highest Grid Block Average (dpm/100 cm ²)		Total Activity (dpm/100 cm ²)		Removable Activity (dpm/100 cm ²)		Meets Guideline?
			Grid Blocks	Single-Points	α	β	α range	β range	α range	β range	
24	106	Upper Walls and Ceiling	—	5	N/A	N/A	<110	<410	<6	<13	Yes
		Trench #1	—	10	N/A	N/A	<110 - 110	<410 - 800	<6-6	<13	Yes
		Trench #2	—	10	N/A	N/A	<110	<410 - 470	<6	<13	Yes
25	1st Floor	Floor	1	6	<110	740	<110	<410 - 1,600	<6	<13	Yes
	Mezzanine	North Wall Channels	—	11	N/A	N/A	<11 - 210	<410 - 550	<6	<13	Yes
25	Mezzanine	Floor adjacent to remediated North Wall	—	2	N/A	N/A	<110	<410	—	—	Yes
		Scale Platform	—	1	N/A	N/A	<110	<410	<6	<13	Yes
		Work Bench	Area Surface Scanned and BNI Data Reviewed.								
26	103	Floor	1	5	<62	<410	<62 - 68	<410	<6	<13	Yes
		Lower Wall	2	1	<62	<410	<62	<410	<6	<13	Yes
		Upper Walls/Ceilings	—	6	N/A	N/A	<62	<410 - 860	<6	<13	Yes
		North Pit	—	5	N/A	N/A	<62 - 68	<410 - 600	<6	<13	Yes
		South Pit	—	5	N/A	N/A	<62	<410	<6	<13	Yes
28	Basement	Toledo Scale	—	10	N/A	N/A	<62	<410 - 1,000	<6	<13	Yes
		Hoskin Furnace #32183	1	1	240	740	<62 - 380	<410 - 1,200	<6	<13	Yes
		Lindberg Furnace #60749	—	2	N/A	N/A	<62	<410	<6	<13	Yes

TABLE 1 (Continued)

**SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
FOR AREAS WITH TH-232 GUIDELINES OF 1000/3000/200
ALBANY RESEARCH CENTER
ALBANY, OREGON**

Bldg.	Room	Location*	# of Measurement Locations		Highest Grid Block Average (dpm/100 cm ²)		Total Activity (dpm/100 cm ²)		Removable Activity (dpm/100 cm ²)		Meets Guideline?
			Grid Blocks	Single-Points	α	β	α range	β range	α range	β range	
28	Basement	Electric Hacksaw #35712	—	2	N/A	N/A	<62	<410	<6	<13	Yes
		Welding Rod Rack	—	1	N/A	N/A	<62	<410	<6	<13	Yes
		Sump Pit #3	—	5	N/A	N/A	<62 - 250	700 - 1,600 ^d	<6	<13	Yes ^d
		Sump Pit #4	—	4	N/A	N/A	<62 - 630	<410 - 5,800	<6	<13	H/A
		Sump Pit #6	—	4	N/A	N/A	<62	450 - 510	<6	<13	Yes
		Sump Pit #7	—	2	N/A	N/A	<62	<410 - 580	<6	<13	Yes
		Sump Pit #9	—	2	N/A	N/A	<62	570 - 790	<6	<13	Yes
		Sump Pit #11	—	2	N/A	N/A	<62	<410 - 450	<6	<13	Yes
		Floor	2	13	68	890	<62 - 170	<410 - 1,300	<6	<13	Yes
	Attic	Trusses and Braces	—	7	N/A	N/A	<62 - 85	<410 - 800	<6	<13	Yes
29	106	Floor	—	5	N/A	N/A	<80 - 90	<850	<6	<13	Yes
	109	Floor	—	13	N/A	N/A	<80	<850	<6	<13	Yes
		Lower Wall	—	5	N/A	N/A	<80	<850	<6	<13	Yes
	111	Floor/Drains	—	21	N/A	N/A	<80	<850 - 1,000	<6	<13	Yes
	113	HEPA Filter	—	8	N/A	N/A	<80	<850	<6	<13	Yes
31	1A		Area Surface Scanned and BNI Data Reviewed.								Yes
	2	Floor	—	5	N/A	N/A	<110	580 - 710	<6	<13	Yes
		Lower Wall	1	3	<110	750	<110	<350 - 1,000	<6	<13	Yes
	3	Floor	1	3	<62	<410	<62	<410	<6	<13	Yes

TABLE 1 (Continued)

**SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
FOR AREAS WITH TH-232 GUIDELINES OF 1000/3000/200
ALBANY RESEARCH CENTER
ALBANY, OREGON**

Bldg.	Room	Location ^a	# of Measurement Locations		Highest Grid Block Average (dpm/100 cm ²)		Total Activity (dpm/100 cm ²)		Removable Activity (dpm/100 cm ²)		Meets Guideline?
			Grid Blocks	Single-Points	α	β	α range	β range	α range	β range	
31	3	Lower Wall	---	1	N/A	N/A	<62	<410	<6	<13	Yes
		Storage Area	Area Surface Scanned and BNI Data Reviewed.								Yes
33	103	Floor	---	5	N/A	N/A	<80	<850	<6	<13	Yes
	104	Floor	---	9	N/A	N/A	<80	<850	<6	<13	Yes
		Lower Wall	---	3	N/A	N/A	<80	<850	<6	<13	Yes
27	Exterior	East Side	3	7	<62	570	<62	<440 - 820	<6 - 11	<13 - 27	Yes

^aRefer to Figures 3-159.

^bNo measurement performed.

^cN/A - Not applicable.

^dGrid Block measurement not performed. Additional single-point measurements performed within a contiguous 1 m² area resulted in average activity of <1000 dpm/100 cm².

^eH/A - Hazard Assessment.

**SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
FOR AREAS WITH URANIUM GUIDELINES OF 5000/15,000/1000
ALBANY RESEARCH CENTER
ALBANY, OREGON**

Bldg.	Room	Location*	# of Measurement Locations		Highest Grid Block Average (dpm/100 cm ²)		Total Activity (dpm/100 cm ²)		Removable Activity (dpm/100 cm ²)		Meets Guideline?
			Grid Block	Single-Points	α	β	α range	β range	α range	β range	
17	Lab 10	Floor	5	8	210	3100	<62 - 460	<440 - 13,000	<6 ^b	<13 ^b	Yes
		South Wall Attic Floor	Area Surface Scanned and BNI Data Reviewed.								Yes
	Attic	Roof Area 8	— ^c	15	N/A ^d	N/A	76 - 920	<860	<6 - 19	<13	Yes
		Roof Area 11	—	15	N/A	N/A	<62 - 580	<860 - 1,200	<6 - 17	<13 - 13	Yes
		Truss 9	—	8	N/A	N/A	<62 - 900	<860 - 1,500	<6 - 15	<13 - 26	Yes
		Roof Eave	—	6	N/A	N/A	<62 - 780	<860 - 2,300	<6	<13	Yes
	2nd Floor Storage	Floor	2	1	<83	<440	<83	<440	<6	<13	Yes
		Lower Walls	—	3	<83	<440	<83	<440	<6	<13	Yes
		Upper Walls	—	2	N/A	N/A	<83	<440	<6	<13	Yes
		North and South Trusses	—	11	N/A	N/A	<83	<440	<6	<13	Yes
		Cabinet	—	3	N/A	N/A	<62 - 160	<410 - 520	<6	15-19	Yes
	2nd Floor Supply/ Storage	Floor	1	—	<62	<890	<62	<890	<6	<13	Yes
		Lower Wall	3	6	150	1600	<62 - 280	<890 - 2,700	<6	<13	Yes
		Mens Room Fixtures	Area Surface Scanned and BNI Data Reviewed.								Yes

TABLE 2 (Continued)

**SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
FOR AREAS WITH URANIUM GUIDELINES OF 5000/15,000/1000
ALBANY RESEARCH CENTER
ALBANY, OREGON**

Bldg.	Room	Location ^a	# of Measurement Locations		Highest Grid Block Average (dpm/100 cm ²)		Total Activity (dpm/100 cm ²)		Removable Activity (dpm/100 cm ²)		Meets Guideline?
			Grid Blocks	Single-Points	α	β	α range	β range	α range	β range	
28	3	Floor	---	3	N/A	N/A	<110 - 340	<830	<6	<13	Yes
		Lower Wall	---	1	N/A	N/A	<110	<830	<6	<13	Yes
	Hallway Outside Lab 3	Floor	1	4	<62	1200	<62 - 68	<410 - 2,400	<6	<13	Yes
		Lower Wall	1	1	<62	<410	<62	<410	<6	<13	Yes
	13	Floor	---	5	N/A	N/A	<62	<410 - 1,100	<6	<13	Yes
	15	Floor	5	7	110	740	<62 - 520	<410 - 2,400	<6	<13	Yes
		Lower Walls	2	4	<62	<410	<62	<410 - 430	<6	<13	Yes
		Equipment	---	2	N/A	N/A	<62 - 68	<410 - 440	<6	<13	Yes

^aRefer to Figures 31, 39-42, 107-115.

^bRemovable activity guideline 200 dpm/100 cm².

^c---No measurement performed.

^dN/A = Not applicable.

TABLE 3

SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
FOR AREAS WITH SUPPLEMENTAL GUIDELINES OF 4000/12,000/800
ALBANY RESEARCH CENTER
ALBANY, OREGON

Bldg.	Room	Location*	# of Measurement Locations		Highest Grid Block Average (dpm/100 cm ²)		Total Activity (dpm/100 cm ²)		Removable Activity (dpm/100 cm ²)		Meets Guidelines?
			Grid Block	Single Points	α	β	α range	β range	α range	β range	
17	Lab 10	Lower Walls	— ^b	18	N/A ^c	N/A	<62	2,600	<6	<13	Yes
		East Wall Electrical Panel	—	6	N/A	N/A	<62	600 - 4,600 ^d	<6	<13	Yes
		Trusses 3, 4 & 5	—	6	N/A	N/A	<62	<410 - 2,200	<6	<13	Yes
		Rafters	—	10	N/A	N/A	<62 - 820	<410 - 2,500	<6	<13 - 33	Yes
		Cross Braces and Supports	—	3	N/A	N/A	<62 - 350	<860 - 1,800	<6	<13	Yes
		North Wall Electrical Panel	Area Surface Scanned and BNI Data Reviewed.								Yes
30	Fabrication Room	East Floor	2	17	<83	840	<83 - 85	<440 - 3,200	<6	<13	Yes
		Lower East Wall	1	—	<83	<440	<83	<440	<6	<13	Yes
		Northeast Corner Floor Wall Interface	—	5	N/A	N/A	<62 - 120	<410 - 1,800	<6	<13	Yes
		Shear #33988	—	2	N/A	N/A	<62 - 93	820 - 1,800	<6	<13	Yes
		Hydrogen Oven #50430	—	1	N/A	N/A	<83	<440	<6	<13	Yes
		Keith Oven #52478	—	4	N/A	N/A	<69	<440	<6	<13	Yes
		Hevi-Duty Oven #35693	—	7	N/A	N/A	<69 - 75	<440	<6	<13	Yes
		Portable Rolling Mill #52544	—	3	N/A	N/A	<69	<380 - 750	<6	<13	Yes

TABLE 3 (Continued)

**SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
FOR AREAS WITH SUPPLEMENTAL GUIDELINES OF 4000/12,000/800
ALBANY RESEARCH CENTER
ALBANY, OREGON**

Bldg.	Room	Location*	# of Measurement Locations		Highest Grid Block Average (dpm/100 cm ²)		Total Activity (dpm/100 cm ²)		Removable Activity (dpm/100 cm ²)		Meets Guideline?
			Grid Block	Single-Points	α	β	α range	β range	α range	β range	
30	Fabrication Room	Hoskins Furnace #39242	—		N/A	N/A	<69 - 75	<440 - 490	<6	<13	Yes
		Portable Electric Oven #34840 Electrical Panel	—	6	N/A	N/A	<69	<440	<6	<13	Yes
		Loma Roller #53550	—	10	N/A	N/A	<62 - 110	<410 - 910	<6	<13	Yes
		HPM Hydraulic Press #34469	1	17	990	1600	<62 - 1,800	<410 - 24,000	<6	<13	No - H/A*
		Steel Anvils HPM Press	—	2	N/A	N/A	<62	<410	<6	<13	Yes
		Extruder #40659	—	4	N/A	N/A	<62 - 68	<410	<6	<13	Yes
		Extruder #38347	—	4	N/A	N/A	<62	<410	<6	<13	Yes
		Extruder #38348	—	4	N/A	N/A	<62	<410	<6	<13	Yes
		Furnace #38308	—	2	N/A	N/A	<62	<890 - 980	<6	<13	Yes
		Transfer Cart	—	2	N/A	N/A	<62	<410	<6 - 11	<13	Yes

TABLE 3 (Continued)

**SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
FOR AREAS WITH SUPPLEMENTAL GUIDELINES OF 4000/12,000/800
ALBANY RESEARCH CENTER
ALBANY, OREGON**

Bldg.	Room	Location ^a	# of Measurement Locations		Highest Grid Block Average (dpm/100 cm ²)		Total Activity (dpm/100 cm ²)		Removable Activity (dpm/100 cm ²)		Meets Guideline?
			Grid Block	Single Points	α	β	α range	β range	α range	β range	
30	Fabrication Shop	Lindberg Furnace #40424	—	4	N/A	N/A	< 69 - 1900	< 860 - 9,000	< 6 - 15	< 13	No - H/A
		Brinell Hardness Testing Machine #24274	—	2	N/A	N/A	< 62	< 860	< 6	< 13	Yes
		Rolling Mill #39974	—	2	N/A	N/A	< 62	< 860 - 5,100 ^d	< 6	< 13	Yes
		Clark Puller #34679	—	2	N/A	N/A	< 62	< 860 - 1,400	< 6 - 7	< 13	Yes
		Baldwin Press #39768	—	3	N/A	N/A	76 - 1100	< 410 - 75,000	< 6 - 180	< 13 - 170	No-HA
		Mezzanine	1	6	< 62	< 890	< 62	< 890	< 6	< 13	Yes

^aRefer to Figures 31-34, 124-145.

^bNo measurement made.

^cN/A = Not applicable.

^d Grid Block measurement not performed. Additional single-point measurements performed within a contiguous 1 m² area resulted in average activity of < 1000 dpm/100 cm².

^eH/A = Hazard assessed.

TABLE 4

**SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
FOR AREAS WITH SUPPLEMENTAL GUIDELINES OF <2500/7500/500
ALBANY RESEARCH CENTER
ALBANY, OREGON**

Bldg.	Room	Location ^a	# of Measurement Locations		Highest Grid Block Average (dpm/100 cm ²)		Total Activity (dpm/100 cm ²)		Removable Activity (dpm/100 cm ²)		Meets Guideline?
			Grid Block	Single-Points	α	β	α range	β range	α range	β range	
31	Attic	Top of North Wall	— ^b	8	N/A ^c	N/A	110 - 300	1,800 - 2,400	<6	<13	Yes
		Eaves	—	8	N/A	N/A	<62 - 640	<420 - 2,500	<6	<13	Yes
		Storage Area	Area Surface Scanned and BNI Data Reviewed.								Yes

^aRefer to Figure 149.

^b—No measurement performed.

^cN/A = Not applicable.

TABLE 5

**SUMMARY OF SURFACE ACTIVITY MEASUREMENTS
FOR AREAS WITH SUPPLEMENTAL GUIDELINES OF 1600/4800/320
ALBANY RESEARCH CENTER
ALBANY, OREGON**

Bldg.	Room	Location*	# of Measurement Locations		Highest Grid Block Average (dpm/100 cm ²)		Total Activity (dpm/100 cm ²)		Removable Activity (dpm/100 cm ²)		Meets Guideline?
			Grid Block	Single-Points	α	β	α range	β range	α range	β range	
28	Basement	Sump Pit #12	1	4	<62	500	<62	<410 - 820	<6	<13	Yes

*Refer to Figure 104.

TABLE 6

**RADIONUCLIDE CONCENTRATIONS IN SOIL AND CONCRETE
ALBANY RESEARCH CENTER
ALBANY, OREGON**

Building	Location	Figure #	Radionuclide Concentration (pCi/g)			
			Sample Type	Ra-226	Th-232	U-238
4	Room 105 East Pit	14	Concrete	1.0 ± 0.3^a	1.6 ± 0.5	3.1 ± 1.9
	Room 106 Pit	15	Soil	0.9 ± 0.3	1.1 ± 0.5	2.5 ± 1.4
5	Plumbing Shop Interior 0N, 18E	19	Soil	0.8 ± 0.3	0.7 ± 0.5	<2.0
	Plumbing Shop Exterior	22	Composite Soil	0.9 ± 0.1	1.6 ± 0.4	2.3 ± 1.3
	Machine Shop Interior 7N, 7E	24	Soil	0.6 ± 0.1	0.9 ± 0.3	3.4 ± 2.1
17	Men's Room Valve Pit	28	Soil	0.8 ± 0.2	1.2 ± 0.5	3.4 ± 1.5
26	Room 103 South Pit	94	Soil	0.7 ± 0.3	1.0 ± 0.6	<2.0
	Room 103 North Pit	94	Soil	0.4 ± 0.3	<1.5	<2.0
27	West Excavation 10N, 20W	153	Soil	0.9 ± 0.2	3.1 ± 0.2	<4.8
	Beneath Building 43N, 2E	153	Soil	1.1 ± 0.3	2.8 ± 0.5	3.3 ± 1.3
Lime Pit	Pits 3&5 (Composite)	156 & 157	Concrete	0.7 ± 0.2	0.6 ± 0.3	4.2 ± 1.1
	North Excavation 21.5N, 5E	158	Soil	0.7 ± 0.1	3.3 ± 0.6	7.1 ± 3.9
	North Excavation 13.5N, 2E	158	Soil	0.6 ± 0.2	0.9 ± 0.3	11.6 ± 0.1
30/31	South Excavation	159	Soil	0.7 ± 0.1	3.3 ± 0.6	7.1 ± 3.9

^a Uncertainties represent the 95% confidence level, based only on counting statistics; additional laboratory uncertainties of ± 6 to 10% have not been propagated into these data.

TABLE 7
SUMMARY OF LOCATIONS IN EXCESS OF DOE GUIDELINES
ALBANY RESEARCH CENTER
ALBANY, OREGON

Location	Figure #	Surface	dpm/100 cm ² Total Activity		Status
			α Range	β Range	
Building 23, Lab 1					
Trench 1	58	Trench Floor	< 69	< 440 - 1,600	Hazard Assessment
Trench 2	59	Trench Floor	< 69	< 440 - 1,400	Hazard Assessment
Trench 18	72	Trench Floor	< 62 - 300	< 410 - 2,300	Hazard Assessment
Trench 7	64	Pipe	NA	11,000	Hazard Assessment
Building 28, Basement					
Sump Pit 4	102	Pipe	< 62 - 630	< 410 - 5,800	Hazard Assessment

TABLE 7 (continued)

**SUMMARY OF LOCATIONS IN EXCESS OF DOE GUIDELINES
ALBANY RESEARCH CENTER
ALBANY, OREGON**

Location	Figure #	Surface	dpm/100 cm ² Total Activity		Status
			α Range	β Range	
Building 30					
Fabrication Room	134	Hydraulic Press	< 62 - 1,800	< 410 - 24,000	Hazard Assessment
Fabrication Room	145	Baldwin Press	76 - 1,100	< 410 - 75,000	Hazard Assessment
Fabrication Room	140	Lindberg Furnace	< 69 - 1,900	< 860 - 9,000	Hazard Assessment
Building 23					
Crusher Room	51	Conical Mill	NA	< 380 - 6,200	ARC Accepted
Crusher Room	50	Vent Pipe	NA	10,000	ARC Accepted

REFERENCES

1. Bechtel National Inc., Radiological Survey of the Albany Research Center, Albany, Oregon, January 1985.
2. Bechtel National Inc., Post-Remedial Action Report for the Albany Research Center, Albany, Oregon, April 1989.
3. Bechtel National Inc., Radiological Characterization Report for the Albany Research Center, Albany, Oregon, April 1989, DOE/OR/20722-204.
4. P.R. Cotten, Verification of Remedial Actions, Albany Research Center, Albany, Oregon, Oak Ridge Associated Universities, October 1989.
5. T.J. Vitkus and P.R. Cotten, Verification Survey of Phase II Remedial Actions, Albany Research Center, Albany, Oregon, Interim Report, Oak Ridge Associated Universities, January 1991.
6. T.J. Vitkus, Verification Survey of Phase II Remedial Actions, Albany Research Center, Albany, Oregon, Interim Report II, Oak Ridge Associated Universities, March 1991.
7. T.J. Vitkus, Verification Survey of Phase II Remedial Actions, Albany Research Center, Albany, Oregon, Interim Report III, Oak Ridge Associated Universities, June 1991.
8. Bechtel National Inc., Hazard Assessment For Radioactive Contamination In and Beneath Certain Buildings at the Albany Research Center, Albany, Oregon, September 1989.
9. Bechtel National Inc., Addendum to the Hazard Assessment for Radioactive Contamination in and Beneath Certain Buildings at the Albany Research Center, Albany, Oregon, March 1992.
10. Bechtel National Inc., Post-Remedial Action Report for Phase II Work Conducted During 1990-1991 at the Albany Research Center, Albany, Oregon, May 1992.

11. Memorandum, James W. Wagoner II, Acting Chief, Off-Site Branch, Division of Eastern Area Programs, Office of Environmental Restoration, Department of Energy, to Lester K. Price, Director, Technical Services Division, Oak Ridge Operations Office, Department of Energy, "Approval of Supplemental Limits at Albany Research Center," September 11, 1990.
12. Letter, S. D. Liedle, Project Manager - FUSRAP, Bechtel National Inc., to David G. Adler, Site Manager, Former Sites Restoration Division, Department of Energy, "Cleanup Criteria for Building 17, Room 10 at the Albany Research Center," December 4, 1990.
13. Letter, S. D. Liedle, Project Manager - FUSRAP, Bechtel National Inc., to David G. Adler, Site Manager, Former Sites Restoration Division, Department of Energy, "Cleanup Criteria for the Albany Research Center," July 3, 1990.
14. Letter, S. D. Liedle, Project Manager - FUSRAP, Bechtel National Inc., to David G. Adler, Site Manager, Former Sites Restoration Division, Department of Energy, "Cleanup Criteria for the Albany Research Center," May 8, 1991.
15. Memorandum, James W. Wagoner II, Director, Off-site Branch, Office of Environmental Restoration, Department of Energy, to David Adler, Site Manager, Former Sites Restoration Division, Department of Energy, "Addendum to the Hazard Assessment for Radioactive Contamination In and Beneath Certain Buildings at the Albany Research Center," April 28, 1992.

APPENDIX A
MAJOR INSTRUMENTATION

APPENDIX A

MAJOR INSTRUMENTATION

The display or description of a specific product is not to be construed as an endorsement of that product or its manufacturer by the authors or their employer.

DIRECT RADIATION MEASUREMENTS

Instruments

Eberline "RASCAL"
Portable Ratemeter-Scaler
Model PRS-1
(Eberline, Santa Fe, NM)

Eberline
Portable Ratemeter
Model PRM-6
(Eberline, Santa Fe, NM)

Ludlum Ratemeter-Scaler
Model 2221
(Ludlum, Sweetwater, TX)

Detectors

Eberline Alpha Scintillation Detector
Model AC-3-7
Effective Area, 59 cm²
(Eberline, Santa Fe, NM)

Eberline GM Detector
Model HP-260
Effective Area, 15.5 cm²
(Eberline, Santa Fe, NM)

Eberline Shielded GM Detector
Model HP-210L
Effective Area, 15.5 cm²
(Eberline, Santa Fe, NM)

Ludlum Gas Proportional Detector
Model 43-68
Effective Area, 100 cm²
(Ludlum, Sweetwater, TX)

Ludlum Gas Proportional Detector
Model 43-37
Effective Area, 550 cm²
(Ludlum Measurements, Sweetwater, TX)
Used in Conjunction with:
Ludlum Floor Monitor
Model 239-1
(Ludlum Measurement Inc., Sweetwater, TX)

Victoreen NaI(Tl) Scintillation Detector
Model 489-55
3.2 cm x 3.8 cm Crystal
(Victoreen, Cleveland, OH)

LABORATORY ANALYTICAL EQUIPMENT

Low Background Gas Proportional Counter
Model LB-5110
(Tennelec, Oak Ridge, TN)

High-Purity Germanium Detector
Model GMX-23195-S, 23% efficiency
(EG&G ORTEC, Oak Ridge, TN)
Used in conjunction with:
Lead Shield, G-16
(Gamma Products, Inc., Palos Hills, IL)

High-Purity Germanium Coaxial Well Detector
Model GWL-110210-PWS-S, 23% efficiency
(EG&G ORTEC, Oak Ridge, TN)

Used in conjunction with:
Lead Shield Model G-16
(Applied Physical Technology, Atlanta, GA)

Multichannel Analyzer
ND-66/Micro VaxII
(Digital Equipment Corp., Maynard, MA)

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

Surface Scans

Surface scans were performed by passing the probes slowly over the surface; the distance between the probe and the surface was maintained at a minimum - nominally about 1 cm. Identification of elevated levels was based on increases in the audible signal from the recording or indicating instrument. A large surface area, gas proportional floor monitor, with a 550 cm² sensitive area detector, was used to scan the floors of the surveyed areas. Other surfaces were scanned using smaller, hand-held detectors. Combinations of detectors and instruments used for the scans were:

- | | | |
|------------|---|---|
| Alpha-Beta | - | Ludlum Model 43-37 gas proportional detector (550 cm ²), with
Ludlum Model 2221 ratemeter-scaler. |
| | - | Ludlum Model 43-68 gas proportional detector (100 cm ²), with
Ludlum Model 2221 ratemeter-scaler. |
| Alpha | - | Eberline Model AC-3-7 ZnS scintillation detector (59 cm ²), with
Eberline Model PRS-1 ratemeter-scaler. |
| Beta | - | Eberline Model HP260 GM detector (15.5 cm ²), with Eberline
Model PRS-1 ratemeter-scaler. |
| | - | Eberline Model HP210L GM detector (15 cm ²), with Eberline
Model PRS-1 ratemeter-scaler. |
| Gamma | - | Victoreen Model 489-55 NaI(Tl) scintillation detector (3.2 cm x
3.8 cm crystal) with Eberline Model PRM-6 ratemeter. |

Removable Measurements

Smears for determination of removable activity levels were performed using numbered filter paper disks, 47 mm in diameter. When necessary, field counting of smears was performed using an Eberline Model HP210L shielded GM detector with an Eberline Model PRS-1 portable ratemeter-scaler. The effective window area was 15.5 cm² and the efficiency was 16%. Smears were sealed in labeled envelopes with the location and other pertinent information recorded. The smears were then returned to the Oak Ridge laboratories and counted on a low background gas-proportional counter for gross alpha and gross beta activity.

Gamma Spectrometry

Samples were placed in an appropriate container, chosen to reproduce the calibrated counting geometry. Net weights were determined and the samples counted using a high purity germanium detector coupled to a Nuclear Data Model ND-66/Micro VaxII pulse height analyzer system. Background and Compton stripping, peak search, peak identification, and concentration calculations were performed using the computer capabilities inherent in the analyzer system. The energy peaks used for determination of the radionuclides of concern were:

Ra-226	0.609 MeV from Bi-214*
Th-232	0.911 MeV from Ac-228*
U-238	0.093 MeV from Th-234*

*Secular equilibrium assumed.

Spectra were reviewed for other identifiable photopeaks.

Uncertainties and Detection Limits

The uncertainties associated with the analytical data presented in the tables of this report represent the 95% confidence levels for that data. These uncertainties were calculated based on both the gross sample count levels and the associated background count levels. When the net

sample count was less than the 95% statistical deviation of the background count, the sample concentration was reported as less than the detection limit of the measurement procedure. Because of variations in background levels, measurement efficiencies, and contributions from other radionuclides in samples, the detection limits differ from sample to sample and instrument to instrument. Additional uncertainties, associated with sampling and measurement activities have not been propagated into the data presented in this report.

Calibration and Quality Assurance

The Environmental Survey and Site Assessment Program conducted the survey and analytical activities in accordance with procedures developed specifically for the Oak Ridge Institute for Science and Education. The specific manuals and procedures applicable to this survey were the "Quality Assurance Manual," February 1990, Revision 3; "Survey Procedures Manual," March 1990, Revision 5 and February 1991, Revision 6; and the "Laboratory Procedures Manual," February 1990, Revision 5.

With the exception of the measurements conducted with portable gamma scintillation survey meters, instruments were calibrated with NIST-traceable standards.

Quality control procedures on all instruments included daily background and check-source measurements to confirm equipment operation within acceptable statistical fluctuations. The ORISE laboratory participates in the EPA and EML Quality Assurance Programs.

APPENDIX C

RESIDUAL RADIOACTIVE MATERIAL GUIDELINES SUMMARIZED FROM DOE ORDER 5400.5

APPENDIX C **RESIDUAL RADIOACTIVE MATERIAL GUIDELINES SUMMARIZED** **FROM DOE ORDER 5400.5¹**

BASIC DOSE LIMITS

The basic limit for the annual radiation dose (excluding radon) received by an individual member of the general public is 100 mrem/yr. In implementing this limit, DOE applies as low as reasonable achievable principles to set site-specific guidelines.

STRUCTURE GUIDELINES

Indoor/Outdoor Structure Surface Contamination

Radionuclides ²	Allowable Total Residual Surface Contamination		
	Average ^{3,4}	(dpm/100 cm ²) ¹ Maximum ^{4,5}	Removable ^{4,6}
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100	300	20
Th-Natural, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000	3,000	200
U-Natural, U-235, U-238, and associated decay products	5,000 α	15,000 α	1,000 α
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above. ⁷	5,000 β - γ	15,000 β - γ	1,000 β - γ

¹ As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute measured by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

² Where surface contamination by both alpha- and beta-gamma-emitting radionuclides exists, the limits established for alpha- and beta-gamma-emitting radionuclides should apply independently.

³ Measurements of average contamination should not be averaged over an area of more than 1m². For objects of less surface area, the average should be derived for each such object.

⁴ The average and maximum dose rates associated with surface contamination resulting from beta-gamma-emitters should not exceed 0.2 mrad/h and 1.0 mrad/h, respectively, at 1 cm.

⁵ The maximum contamination level applies to an area of not more than 100 cm².

⁶ The amount of removable material per 100 cm² of surface area should be determined by wiping an area of that size with dry filter or soft absorbent paper, applying moderate pressure, and measuring the amount of radioactive material on the wiping with an appropriate instrument of known efficiency. When removable contamination on objects of surface area less than 100 cm² is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. It is not necessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate that total residual surface contamination levels are within the limits for removable contamination.

⁷ This category of radionuclides includes mixed fission products, including the Sr-90 which is present in them. It does not apply to Sr-90, which has been separated from the other fission products, or mixtures where the Sr-90 has been enriched.

External Gamma Radiation

The average level of gamma radiation inside a building or habitable structure on a site that has no radiological restriction on its use shall not exceed the background level by more than 20 μ R/h and will comply with the basic dose limits when an appropriate-use scenario is considered.

SOIL GUIDELINES

Radionuclides	Soil Concentration (pCi/g) Above Background ^{8,9,10}
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Radium-226	5 pCi/g when averaged over the first 15 cm of soil below the surface; 15 pCi/g when averaged over any 15-cm-thick soil layer below the surface layer.
Radium-228	
Thorium-230	
Thorium-232	

Uranium	Soil guidelines are calculated on a site-specific basis, using the DOE manual developed for this use.
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⁸ These guidelines represent allowable residual concentrations above background averaged across any 15-cm-thick layer to any depth and over any contiguous 100 m² surface area.

⁹ These guidelines take into account ingrowth of radium-226 from thorium-230 or thorium-232 and radium-228 and assume secular equilibrium. If either Th-230 and Ra-226 or Th-232 and Ra-228 are both present, not in secular equilibrium, the guidelines apply to the higher concentration. If other mixtures of radionuclides occur, the concentrations of individual radionuclides shall be reduced so that (1) the dose for the mixtures will not exceed the basic dose limit, or (2) the sum of ratios of the soil concentration of each radionuclide to the allowable limit for that radionuclide will not exceed 1 ("unity").

¹⁰ If the average concentration in any surface or below-surface area, less than or equal to 25 m², exceeds the authorized limit of guideline by a factor of $(100/A)^{1/2}$, where A is the area or the elevated region in square meters, limits for "hot spots" shall also be applicable. Procedures for calculating these hot spot limits, which depend on the extent of the elevated local concentrations, are given in the DOE Manual for Implementing Residual Radioactive Materials Guidelines, DOE/CH/8901.² In addition, every reasonable effort shall be made to remove any source of radionuclide that exceeds 30 times the appropriate limit for soil, irrespective of the average concentration in the soil.

REFERENCES

1. "Radiation Protection of the Public and the Environment", DOE Order 5400.5, U.S. Department of Energy, February 8, 1990.
2. Argonne National Laboratory, "A Manual for Implementing Residual Radioactive Material Guidelines", DOE/CH/8901, June 1989.